SCIENCE

NEW SERIES
VOL. 95, No. 2463

FRIDAY, MARCH 13, 1942

SUBSCRIPTION, $6.00
SINGLE COPIES, .15

Science: published weekly by The Science Press, Lancaster, Pa.
Entered as second-class matter July 18, 1923, at the Post Office at Lancaster, Pa., under the Act of March 3, 1879.

SCIENCE

VOL. 95 FRIDAY, MARCH 13, 1942 No. 2463

SCIENCE: A Weekly Journal devoted to the Advancement of Science, edited by J. MCKEEN CATTELL and published every Friday by

THE SCIENCE PRESS

Lancaster, Pa. Garrison, N. Y.

New York City: Grand Central Terminal

Annual Subscription, $6.00 Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science. Information regarding membership in the Association may be secured from the office of the permanent secretary in the Smithsonian Institution Building, Washington, D. C.

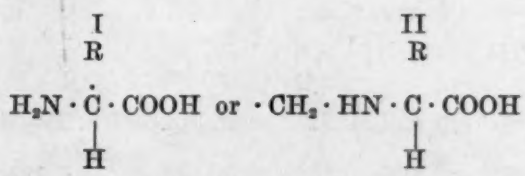
PHYSIOLOGY OF THE AMINO ACIDS[1]

By Dr. DONALD D. VAN SLYKE

THE HOSPITAL OF THE ROCKEFELLER INSTITUTE FOR MEDICAL RESEARCH, NEW YORK, N. Y.

Amino Acid Structure of the Proteins. The tissues of our bodies, skin, muscle, tendon, are chiefly protein substances. The number of proteins in the animal and vegetable world appears to be infinite. Yet they are all constructed of about twenty-one units, called the amino acids. These have an extraordinary ability to link together in chains in numbers up to thousands. One definition of infinity might be the possible number of different protein molecules that could be built by permutations and combinations of the amino acids. The extraordinary thing, in fact, is that nature ever succeeds in duplicating a protein molecule. Perhaps she never does exactly. But she comes so close to it that so far as we can tell the casein of cow's milk is always the same, the proteins of muscle seem to be constant in their properties, and so on through the list of proteins that make up the familiar animal and vegetable structures of which we are constructed and on which we live.

The common structure which all the amino acids possess, and which permits this chain-making, may be formulated as:



All the amino acids except proline and hydroxypro-

[1] From an address given at the Centennial Celebration of the University of Chicago, September, 1941.

line have Structure I, while these two amino acids have II. Each amino acid has an amino group, NH_2 or $NH \cdot CH_2$, which has an alkalinity about equal to that of ammonia; and each has a carboxyl group, COOH, which has the acidity of an unusually strong organic acid. The R represents a chemical group which is different in each amino acid, and gives it its character as an individual.

In proteins Emil Fischer demonstrated that the amino acids are joined, by what he termed peptide linkings, each NH_2 group condensing with the COOH of another amino acid, with elimination of the elements of water. Simple chains of a few amino acids, Fischer termed peptides.

The proteins are peptides of tremendously long chains. These protein chains seem usually to be rolled or folded into balls or otherwise made to take a globular or ellipsoid or sausage shape. Their rates of diffusion were found by Northrop and Anson[1] to approximate the rates that would be calculated for spheres, and the asymmetries calculated from ultra centrifugation are not great. Exceptions are the fibrous proteins, such as silk and wool, in which the molecules appear to be extended into straight wavy chains, long bundles of which make the visible fibers.

Path of Amino Acids through the Body. Except for the transient supply of proteins with which we are born, all those in our bodies are obtained from the proteins of other animals and vegetables, which we eat and digest into their constituent amino acids or simple peptides, and then build into our own tissues. However, only a fraction of the amino acids that we invite into our bodies really find acceptance there as naturalized citizens, integral units of our own structures. Many other fates beset the immigrant amino acid; it may be disintegrated to make some entirely different product; or it may simply be burned for fuel. We shall try to follow some of the paths in the body that are taken by amino acids after digestion and absorption in the alimentary tract.

Methods for Determination of Amino Acids. In studies of protein digestion and of the nature and fate of the digestion products, methods for measuring the amounts of amino acids present in blood and other parts of the body are indispensable tools. Two such methods developed in our laboratory have contributed part of the physiological information that will be discussed.

The first was the "nitrous acid method"[2] which depends on the reaction:

$$R \cdot CH(NH_2) \cdot COOH + HNO_2 = R \cdot CH(OH) \cdot COOH + H_2O + N_2.$$

The N_2 gas is a measure of the amount of amino acid present. The reaction is not entirely specific for amino acids, because other amines with NH_2 groups also react; but such amines are usually not present in important amounts or can be removed.

A later and more specific method[3, 4] depends on reaction with a mild oxidizing agent called ninhydrin. Its effect is indicated by the equation:

$$R \cdot CH(NH_2) \cdot COOH + O = RCHO + NH_3 + CO_2.$$

The analysis consists merely of heating the mixture for a few minutes and measuring the CO_2 evolved. This reaction is so specific for free amino acids that it serves to pick out and measure them in the most diverse mixtures of other amines, organic acids, peptides and other biological products.

Digestion and Absorption. In the human stomach the chief visible change, as noted a century ago by Beaumont[5] through the bullet hole in the stomach of Alexis St. Martin, is that food proteins which enter as insoluble matter, such as meat or coagulated egg white, are dissolved. Chemical studies show that the long protein chains are unrolled and broken into relatively short peptide chains, which still, however, are fairly long. No absorption of the products occurs in the stomach; absorption begins only after the chyme enters the intestine.

In the intestine the chyme meets the enzymes secreted by the pancreas and the intestinal wall. These enzymes hydrolyze the long peptides of the chyme to short peptides containing only 2 or 3 amino acids in the molecule, and to free amino acids. Also, any unchanged protein particles that have escaped the gastric juice are digested. The ability of the intestine to digest, not only gastric peptides, but also intact proteins, makes possible the nutrition of people with achylia gastrica and even of persons who have had the stomach completely removed.

Interchange of Amino Acids between Blood and Tissues. Van Slyke, Cullen and McLean[6] found that in dogs during digestion the amino acid content of the blood rose about 20 per cent. as the blood perfused the intestines, and that the greater part of the absorbed amino acids was removed by the liver. In return, the liver poured into the blood of the hepatic vein an amount of urea nitrogen which almost balanced the amino acid nitrogen that had been taken up. One could watch the work of the liver in taking up the amino acids and destroying them, turning their

[1] J. Northrop and M. L. Anson, *Jour. Gen. Physiol.*, 12: 543, 1928–29.

[2] D. D. Van Slyke, *Jour. Biol. Chem.*, 9: 185, 1911; 12: 275, 1912; 16: 121, 1913; 83: 425, 1929.

[3] D. D. Van Slyke and R. T. Dillon, *Compt. rend. lab. Carlsberg*, 22: 480, 1938.

[4] D. D. Van Slyke, R. T. Dillon, D. A. MacFayden and P. Hamilton, *Jour. Biol. Chem.*, 141: 627, 1941

[5] W. Beaumont, "Experiments and Observations on the Gastric Juice and the Physiology of Digestion," 1833. 1929 edition. Boston.

[6] D. D. Van Slyke, *Arch. Int. Med.*, 19: 56, 1917.

nitrogenous parts into urea for excretion by the kidneys. Unreasonable and wasteful though it seems, a large part of the amino acids absorbed from the intestine appears to be captured and destroyed by the liver, and never to have a chance to reach and nourish the other tissues.

Other experiments, performed with Dr. Gustav Meyer,[7] showed that the liver did not get all the absorbed amino acids, but that some escaped, and could be absorbed by other tissues. It was found that even in the fasting animal the amino acid concentration in the tissues was about 10 times as great as in the blood plasma, *viz.*, about 40 to 60 mg of amino acid nitrogen per 100 grams of tissue, compared with 5 mg per 100 grams of plasma. When amino acids were injected into the circulation they were quickly taken from the blood by the tissues, where the amino acid contents might be increased to 2 or 3-fold their former values. In one experiment the amino nitrogen of the liver rose to 150 mg per 100 grams; in the muscles the increase was never so great. During the next three hours the amino acids in the muscles and kidneys remained practically unchanged, but the amino acids in the liver fell almost back to their original level, and an equivalent of urea nitrogen appeared in the circulation.

Fate of Amino Acids in the Liver. The evidence in these experiments, that the liver is the organ where *urea formation* takes place, supported an old but much contested hypothesis that the liver is the only organ that forms urea. Its unique distinction in this power was confirmed by Bollman, Mann and Magath,[8] of the Mayo Clinic, who showed that removal of the livers from dogs led to an accumulation of amino acids in the blood, and entirely stopped the formation of urea.

Another vicissitude of the amino acids which the work of Mann and his colleagues located in the liver is *transformation into glucose.* Graham Lusk[9] in the early part of the century showed that when protein was catabolized by dogs made totally diabetic by phloridizin poisoning, about 60 grams of glucose were formed and excreted from each 100 grams of protein catabolized. Lusk and his collaborators also showed that when certain amino acids were fed their carbon was partly or entirely turned into glucose when their nitrogen was turned into urea. Mann[8] and his colleagues showed that no glucose formation from proteins or amino acids occurred when the liver was excluded.

[7] D. D. Van Slyke and G. Meyer, *Jour. Biol. Chem.*, 12: 399, 1912; 16: 187, 197, 213 and 231, 1913.

[8] J. L. Bollman, F. C. Mann and T. B. Magath, *Am. Jour. Physiol.*, 69: 371, 1924.

[9] G. Lusk, "The Elements of the Science of Nutrition," Philadelphia, 1928.

Furthermore, the acceleration of the body's heat production that occurs during assimilation of protein digestion products was shown by Mann[8] and his colleagues not to occur when the liver was excluded. This accelerated heat production, called by Rubner the *"specific dynamic action,"* apparently either represents energy produced by the reactions which the amino acids undergo in the liver, or is caused by other reactions in the cells which are stimulated by the presence of products formed in the liver. Such substances must be other than the urea and glucose, for neither of these causes the observed amount of heat acceleration.

Not all the treatment met by the amino acids in the liver is destructive. During periods of heavy protein feeding the body stores considerable amounts of protein in the liver and, in less amounts per gram of tissue, in the other tissues. The *reserve protein* seems to be different from the structural proteins of the tissues. In the liver Berg[10] has shown that it can in fact be differentiated with the microscope by its droplet structure in the cells. Functionally it is characterized by the readiness with which it is metabolized at the onset of starvation, and with which it is used to replace blood proteins depleted by hemorrhage, as found by Whipple[11] and his colleagues.

The liver also appears to be the place where *plasma fibrin and albumin* are formed. It was demonstrated thirty years ago by Whipple[12] that injury of the liver retarded or prevented formation of fibrin. Work by the same author and others[13] has accumulated evidence that the liver is essential also for the formation of the albumin of the plasma. These proteins are presumably formed from free or combined amino acids taken out of the blood by the liver.

Transamination in the Tissues. Some of the amino acids can be synthesized in the body. One of the reactions by which the synthesis occurs has recently been discovered by two Russian biochemists, Braunstein and Kritzman.[14] It is called "transamination," and it enables the cells to change keto-acids, $R \cdot CO \cdot COOH$ to amino acids, $R \cdot CH(NH_2) \cdot COOH$ by replacing the oxygen atom of the ketone CO group with the elements of ammonia. This ammonia, however, must be transferred to the ketone acid from the $CH(NH_2)$ group of one of the dicarboxylic amino acids, aspartic or glutamic. Since at least some of

[10] W. Berg, *Biochem. Z.*, 61: 429, 1914.

[11] F. Robscheit-Robbins and G. H. Whipple, *Am. Jour. Physiol.*, 112: 27, 1935.

[12] G. H. Whipple and S. H. Hurwitz, *Jour. Exp. Med.*, 13: 136, 1911.

[13] S. C. Madden and G. H. Whipple, *Physiol. Rev.*, 20: 194, 1940.

[14] A. E. Braunstein and M. G. Kritzman, *Nature*, 140: 503, 1937; *Idem*, 144: 669, 1939. Also various papers in Biokhimia (Russian), 1937 and later.

the keto acids can be produced by partial oxidation of carbohydrates, transamination appears to be one of the processes by which the body can construct a portion of its own amino acids. The reaction of transamination is caused by an enzyme that occurs in all the tissues, and is rich in the muscles.

Transmethylation. The discovery of du Vigneaud[15] that methyl groups can be transferred from methionine, $CH_3 \cdot S \cdot CH_2 \cdot CH(NH_2) \cdot COOH$, to other substances in the body has opened a field rivaling in interest that of transamination. Du Vigneaud proved that choline could be formed with the aid of methyl groups from methionine. He administered methionine in which the methyl of the $CH_3 \cdot S$ group was marked by hydrogen in the form of deuterium. When this labelled methionine was fed to rats on a choline-free diet choline could be isolated from their tissues with part of its methyl groups containing deuterium. This observation showed that methyl groups had been taken from the methionine to make choline, presumably by methylating ethanolamine. It was found that this marked methyl group could be further transferred from the choline to creatine. The methyl group of the amino acid, methionine, could therefore be used by the body in synthesizing two of its essential non-amino acid constituents, choline and creatine.

The Continual Replacement of Amino Acids in Living Tissue Proteins. The extent to which nitrogen fed in the form of amino acids is synthesized into tissue proteins, both in the form of the fed amino acids and of other amino acids formed in the body from the fed material by transamination or other reactions, has been studied brilliantly by Schoenheimer[16] and his colleagues. They have synthesized amino acids with heavy nitrogen, N^{15}, have fed the amino acids to rats and mice, and have hydrolyzed the proteins in their bodies and isolated various amino acids from the hydrolysates. Finally, they have analyzed the isolated amino acids for N^{15} to determine the amounts of the ingested nitrogen that were built into the body proteins, both in the form of the administered amino acid and in the form of other amino acids derived from the administered one by transamination or other processes. They have found that incorporation into tissue proteins began almost immediately, and that, while more of the marked N^{15} was incorporated in the form of amino acid with which it was administered, than in any other amino acid, nevertheless a considerable proportion of the marked nitrogen was found distributed among other amino acids in the proteins.

The results of Schoenheimer and his colleagues have dispelled the view that the tissue proteins when once laid down remained as unchanging structural blocks until eventually destroyed by the wear and tear of metabolism. It appears that every protein molecule in the living body is itself alive in the sense that it is continually changing and renewing its structure.

Essential and Non-essential Amino Acids for Animal Nutrition. From the fact that by the transaminase action the body can synthesize some of its own amino acids, it would follow that not all the amino acids in the body proteins must be provided ready-made in the food proteins, but that some can be made in the body. The task of finding which of the 21 amino acids are indispensable parts of the diet, and which ones the animal body can build for itself, has occupied some of the leading biochemists since the time of Magnus-Levy's[17] demonstration that the rabbit could make glycine. The names of F. Gowland Hopkins in England and of Lafayette Mendel, T. B. Osborne and W. C. Rose in this country have been especially brilliant in the list of those who have unravelled this problem step by step. As the result of work by all the investigators in the field Rose[18] finally was able to divide the amino acids into the two groups listed in table 1, one which must be supplied in the food of growing rats, while the other group can be made by the rat and need not be supplied in the food. The list does not apply to all animals; for example, glycine is indispensable for the chicken. However, it appears probable, although not yet proven, that the necessities of man and the rat are the same or nearly so.

TABLE I

Essential amino acids must be supplied ready-made in the diet of rats	Non-essential amino acids need not be supplied in the diet of rats
Lysine	Glycine
Tryptophane	Alanine
Histidine	Serine
Phenylalanine	Norleucine
Leucine	Aspartic acid
Isoleucine	Glumatic acid
Threonine	Proline
Methionine	Hydroxyproline
Valine	Tyrosine
Arginine	Cystine
	Hydroxylysine

Detoxifying Effects of Amino Acids. It has long been known that various herbivora and man use glycine to combine with and detoxify benzoic acid by forming hippuric acid:

$$\underset{\text{Glycine}}{CH_2(NH_2) \cdot COOH} + \underset{\text{Benzoic acid}}{C_6H_5 \cdot COOH} = \underset{\text{Hippuric acid}}{CH_2(NH \cdot CO \cdot C_6H_5) \cdot COOH} + H_2O$$

The synthesis appears to occur in the liver, and the

[15] V. du Vigneaud, M. Cohn, J. P. Chandler, J. H. Schenck and S. Simmonds, *Jour. Biol. Chem.*, 140: 625. 1941.

[16] R. Schoenheimer, *Physiol. Rev.*, 20: 218, 1940.

[17] A. Magnus-Levy, *Biochem. Z.*, 6: 523, 1907.

[18] W. C. Rose, SCIENCE, 86: 298, 1937.

ability to form hippuric acid after glycine feeding is used as a test of liver function.[19]

In some much less obvious way cystine and methionine protect the liver from intoxication by chloroform. This peculiar effect of the two sulfur-containing amino acids was discovered by Miller, Ross and Whipple.[20] They had observed that a heavy feeding of meat would protect a dog from the effects of a dose of chloroform that would have led to fatal liver degeneration if administered in the fasting state. Investigation of the different types of amino acids yielded by protein digestion proved that only two containing sulfur had the protective effect.

Nutrition by Intravenously Injected Amino Acids. Henriques and Anderson[21] in Copenhagen demonstrated in 1913 that nitrogen equilibrium could be maintained with intravenously injected amino acids as the sole nitrogen intake. They placed a cannula in the neck vein of a goat kept in a stall, and maintained the animal in nitrogen equilibrium for several weeks by giving the necessary nitrogen in the form of a protein digest hydrolyzed completely to amino acids and injected in a slow stream through the cannula. The therapeutic application did not follow till 25 years later, when Elman[22] began the regular use of intravenous injections of predigested protein. Farr and MacFadyen[23] showed that the injected amino acids were assimilated fully as well as the nitrogen from proteins digested in the alimentary tract. A large part of the nitrogen required can be given in this form for a period of weeks. Whipple[24] and his colleagues and Elman[25] found that when the reserve tissue proteins of dogs had been depleted by fasting and the plasma proteins had also been depleted by bleeding, the proteins could be rapidly restored in tissues and plasma by administering a mixture of amino acids containing all those essential for nutrition, but not if essential amino acids were omitted. It appears that intravenous amino acid administration can be used to nourish the tissues at times when feeding by mouth is impossible or inadvisable.

Formation of Non-Protein Nitrogenous Constituents of the Body from the Amino Acids. Some of the amino acids in the tissues are condensed into peptides. Of these glutathione, which is glutamyl-cysteinyl-glycine,[26] is active in oxidation-reduction reactions. Carnosine, or beta-alanyl-histidine, occurs in mammalian muscle, and presumably has a physiological function. Another compound of beta-alanine is the vitamin, pantothenic acid.[27, 28] Serine combines with phosphoglycerides to form a constituent of nerve tissue.[29] Furthermore, animals have the power to transform the elements of amino acids in more profound ways than by condensation with their amino or carboxyl groups. Animals can be reared with no other nitrogenous foods than proteins and slight amounts of certain nitrogenous vitamins. Hence it appears that all the nitrogenous constituents that occur in large amounts in the animal organism can be formed from the amino acids yielded by the digestion of proteins. Among such constituents are the purines which form part of the nucleic acids of cell nuclei and the creatine of muscle tissue. The hormones thyroxine and adrenalin, from their organic structures, are presumably derived from tyrosine or phenyl alanine.

SUMMARY

We have followed the amino acids from their entrance into the alimentary tract in the form of food proteins through the successive steps of digestion, absorption into the blood stream and passage from the blood stream into the tissues, where they are concentrated by some unknown mechanism to many times their concentration in the blood plasma. We have seen something of the way in which certain of the amino acids can be transformed into one another in the body or synthesized from ammonia and keto acids. However, we have had to admit that our bodies can form in such ways only about half of the different amino acids that are required, and that the other half must be made for us by plants, bacteria or other organisms which have greater synthetic powers than we. And finally we have seen something of the manifold fates of the amino acids after they have entered our tissues; how they may be destroyed and their nitrogenous parts turned into urea in the liver before it is possible to put them to their more specialized uses, how their carbon fractions can be used to form glucose, how they may sacrifice themselves to protect us from toxic products, how they can serve as source material for certain vitamins, hormones and other compounds with physiological functions still to be identified, and how finally those amino acids which are not deflected to these various fates may enter into the proteins of the tissues and become for a time parts of our living structures.

[19] A. J. Quick, *Arch. Int. Med.*, 57: 544, 1936.
[20] L. L. Miller, J. F. Ross and G. H. Whipple, *Am. Jour. Med. Sci.*, 200: 739, 1940.
[21] V. Henriques and A. C. Anderson, *Z. physiol. Chem.*, 88: 357, 1913.
[22] R. Elman, *Proc. Soc. Exp. Biol. Med.*, 36: 867, 1937; *Ann. Surg.*, 112: 594, 1940.
[23] L. E. Farr and D. A. MacFadyen, *Am. Jour. Dis. Child.*, 59: 782, 1940.
[24] S. C. Madden, W. A. Noehren, G. H. Waraich and G. J. Whipple, *Jour. Exp. Med.*, 69: 721, 1939.
[25] R. Elman, *Ann. Surg.*, 112: 594, 1940.
[26] F. G. Hopkins, *Biochem. Jour.*, 15: 287, 1921; *Jour. Biol. Chem.*, 84: 269, 1929.
[27] R. J. Williams and R. T. Major, SCIENCE, 91: 246, 1940.
[28] D. W. Woolley, SCIENCE, 91: 245, 1940.
[29] J. Folch and H. A. Schneider, *Jour. Biol. Chem.*, 137: 51, 1941; 139: 973, 1941.

SIBERIAN RESOURCES FOR SOVIET WARFARE[1]

By Professor GEORGE B. CRESSEY

SYRACUSE UNIVERSITY

IN this complicated world, there are many vital areas for the Allies, but few links in our strategy are more essential than the Soviet Union. Should it collapse, Germany and Japan would be joined and would have access to the wealth of northern Eurasia, with unpredictable consequences to America. German geopolitics has long looked eagerly to the Ukraine and the Caucasus, and the current Soviet victories will assuredly not be accepted by Hitler without challenge. The whole outcome of World War II may turn on the Soviet Union's ability to carry on.

This is a war of competitive production, so that access to raw materials is of vital importance. Geology may not be able to prophesy concerning military ability or morale, but it does have evidence on the material capacity of a country to produce basic war needs.

Two nations lead all others in mineral wealth, the United States and the Union of Soviet Socialist Republics. There is not even a good second unless federations such as the British Commonwealth are included.

It must be admitted that Soviet estimates are optimistic and often incapable of verification, but the general outline is now clear. Those unfamiliar with Soviet geological work in the inter-war period should remember that the Five Year Plans have laid great stress upon heavy industry and the underlying mineral production. Few sciences have received such consideration as geology, and as a result the known reserves have been enlarged several fold.

To sum up the military prospects, it appears probable that even though Germany should occupy all Soviet Europe, or even though Japan should seize Vladivostok; the Ural Mountains and central Siberia still have enough mineral wealth to maintain significant military production as long as the Second World War may last. The current prospects that Hitler's troops will overrun Soviet Europe appear poor, but even should that be the case, the Union still has the minerals, and the industrial capacity, to carry on. This applies not only to undeveloped reserves but to actual mines and smelters now in operation.

I shall review the various resources in a moment, but the situation is well in hand with respect to coal, iron, copper, lead, zinc and gold. Problems may arise concerning oil, aluminum and manganese, but there is a limited output of each within Siberia. In addition to Siberian reserves, there is still great productive capacity in unoccupied Soviet Europe. Large resources of oil, manganese, lead and zinc are available in the Caucasus, and Turkestan is also well supplied with minerals, but this paper is limited to Siberia.

The Soviet Union now credits itself with 1,654,361,000,000 metric tons of coal, second to the U.S.A. Ninety per cent. of this reserve lies in Siberia. So far as current *production* is concerned, three fifths comes from the Donetz field in the Ukraine, still largely in Russian hands, but there has been a great expansion in newer areas in Asia. This is notably true in the Kuznetz Basin of central Siberia, where the current production exceeds 20,000,000 tons, the equivalent of the output in Ohio. In this Kuznetz field the bituminous reserves are more than 450,000,000,000 tons, equal to our entire Appalachian field.

Within the Ural Mountains, coal is mined to the extent of 8,000,000 tons, chiefly at Kizel and Chelyabinsk, but none of it is of coking quality. Elsewhere in Siberia is the new Karaganda field, north of Lake Balkhash, with an output of over 4,000,000 tons; near Lake Baikal are the Cheremkhovo mines yielding 3,000,000 tons; other mines near Vladivostok produce nearly 3,000,000 tons; and a new field is developing at Bureya near the Amur River.

The annual yield of coal in Soviet Asia is 40,000,000 tons out of a national total of 146,800,000 (1940). While the total is but a third of American production, it is quadruple the tsarist output. Since the Kuznetz area is more than 2,000 miles from both German and Japanese frontiers, its operation appears reasonably dependable.

Petroleum production is no longer concentrated in Baku or even along the slopes of the Caucasus, although these still dominate. Northeast of the Caspian Sea is the important Emba district with salt dome structures. From the Urals westward to the Volga River is another new oil field, so promising that the Soviets term it a "second Baku." Siberia proper appears to be very poor in oil, but there is a significant production on the island of Sakhalin north of Japan. A pipe line runs from the Emba fields to Omsk in central Siberia. So long as Baku remains in Soviet hands, there will be no shortage, and the Caucasus Mountains present a formidable barrier to invasion.

Iron ore is wide-spread in the Urals, and forms the basis of imposing blast furnaces at Magnitogorsk, Sverdlovsk and Nizhni Tagil. These have a combined annual capacity of approximately 10,000,000 tons of pig iron, and open hearth furnaces turn out almost

[1] Presented before the Geological Society of America, Boston, December 29, 1941.

as much steel. The furnaces at Magnitogorsk are said to rank next to those of Gary in capacity. The ore is magnetite and secondary martite, formed by contact metamorphism, with a metallic content of 55 to 66 per cent.

Siberia's metallurgical problem does not concern any shortage of iron ore or of coking coal. The difficulty lies in the long rail haul required to bring them together. In the case of the Ural plants, coal is brought 1,417 miles from Kuznetz in central Siberia, while on the return trip the trains carry ore to blast furnaces near the coal. Steel plants thus operate at both ends of the combine. I have spent five days in the Kuznetz Basin, going through mines and blast furnaces, and found them up to the best American standards. Since the development of Kuznetz, nearby ore has been found which nearly meets the need of the local furnaces, while coal for the Urals has been developed at Karaganda, much closer to Magnitogorsk ore. There is a small iron output east of Lake Baikal, and a blast furnace has recently been built in the Far East at Komsomolsk on the lower Amur River.

In the Soviet Union as a whole, the principal steel production has been in the Ukraine, north of the Black Sea, based on Krivoi Rog ore and Donetz coal, but the Ural-Kuznetz combine has grown to the point where it now supplies one third of the nation's iron.

Manganese has been obtained from two major sources; the larger of the deposits is in the Ukraine, but the highest grade ore is in the Caucasus. The latter is still in Soviet hands. Within Siberia itself, there is a limited production of low-grade manganese in the Urals, in the Kazakh Republic and near Kuznetz. While inadequate, these Asiatic manganese deposits provide an emergency supply.

Reserves of copper have been greatly expanded under the Five Year Plans, but the quality of the ore is poor. There is a small production from pyrite-bearing ores and other types in the Ural Mountains, but the largest mines are north and west of Lake Balkhash. These are porphyritic deposits with about 1.1 per cent. copper. A new smelter at Kounrad has an annual capacity of 100,000 tons of metal, and even larger works are getting under way at Djezkazgan.

Lead and zinc reserves are estimated at 11 and 19 per cent. of the world totals, respectively. Soviet production is from the northern Caucasus, from the important Ridder mines in the Altai mountains and from scattered Siberian deposits. Lead production in 1936 amounted to 55,000 tons, while in the same year, zinc totaled 63,000 tons.

Aluminum was regarded as a deficit metal in tsarist Russia because the known bauxite deposits were limited and poor. Within recent years, the U. S. S. R. has built up a significant output, amounting to 60,000 tons in 1939, which lifted the nation to fourth place. Two deposits in the Urals supply a considerable part of the bauxite: Kabakovsk in the north and Kamensk in the south. Unfortunately the chief reduction plants are in those parts of Soviet Europe currently occupied by Germany.

Siberian mineral production also accounts for enough gold to place the Union next to South Africa in second place. This is secured partly from lode mines in the Urals but chiefly from placer works along the tributaries of the Lena River, notably the Aldan. Other Siberian localities are along the Kolyma and Yenisei Rivers. Modest amounts of nickel are mined in the Urals and Arctic. Within the Urals are large amounts of platinum, chromium, asbestos, potash and magnesite; while small amounts of tin and tungsten are produced east of Lake Baikal.

Soviet Europe has the enormous apatite deposits of the Kola Peninsula, the aluminum ores near Leningrad, the brown coal and hematite ores south of Moscow, and great steel centers in the Ukraine based upon local ore and coal. The Caucusus has oil and manganese. Many of these deposits are still in Soviet hands, but even their complete loss would by no means involve the cessation of defense production.

To turn from specific resources to mining areas, two major districts stand out, along with three lesser areas. By far the most valuable is the Urals, for there are few mountain ranges on earth which produce the variety or quantity of minerals secured here. Iron has been mined since the days of Peter the Great, and there are now 39 localities which produce iron or steel. The total reserves of Ural iron ore are placed at 1,390,607,000 tons. Great metallurgical plants provide the base for scores of industries, notably railway equipment, automobiles, tractors, heavy machinery and chemicals. Coal is mined in the Urals but is not of metallurgical quality. Oil is available on the western flanks and also to the south. Non-ferrous minerals include copper, gold, platinum, silver, nickel, aluminum, manganese, lead, zinc, chromium, asbestos, magnesite, potash and salt. All these place the Urals next to the Ukraine as the Union's number two metallurgical base. There are 8 industrial cities of over 100,000 people, led by Sverdlovsk.

The Altai-Sayan Mountains of south-central Siberia are a region whose mineral significance has scarcely been appreciated by non-Russians. Here is a third of the country's coal, lead and zinc, plus significant occurrences of iron ore, silver, gold, copper, tin and manganese. The coal basin of Kuznetz, southeast of Novosibirsk, dominates this second industrial base of Soviet Asia. The development of the Kuznetz steel

works is one of the triumphs of the First Five Year Plan.

Third in significance is the Kazakh area, north of Lake Balkhash, where coal and copper have been developed in the inter-war years.

The fourth of Siberia's minerally-productive districts lies east and west of Lake Baikal, while the fifth is along the Amur River in the Far East. Reserves are considerable but production is only partly developed. Coal and iron are secured in a number of localities, and there is the beginning of a steel industry at Komsomolsk. Petroleum is obtained on the island of Sakhalin.

While Far Eastern developments are somewhat vulnerable to Japanese attack, production in the Urals and at Kuznetz seems secure from any feasible invasion, whether from east or west.

If mineral production will win the war, the Union of Soviet Socialist Republics has what it takes.

During the past two decades, the American public has been very reluctant to recognize the industrial potentialities of the Soviet Union. From the military record of recent months, it should be clear that any nation which can afford to lose tens of thousands of planes and tanks, and millions of soldiers, and still take the initiative, has far greater productive capacities than commonly appreciated. In the post-war world, it seems inescapable that the Soviet Union's geological foundations will place it in the first rank among industrial nations.

OBITUARY

GLOVER MORRILL ALLEN

SCHOLAR as well as student, an enthusiastic zoologist interested quite as much in the history and background of his subject as in the technical details, patient and persevering, with a most extraordinary fund of information and a capacity for methodical, detailed, accurate work possessed by few, taking keen pleasure in helping others though himself shy and retiring and always so far as possible keeping in the background, Dr. Glover Morrill Allen was one of the significantly outstanding mammalogists and ornithologists of his time. His published works are models of directness, clarity and accuracy. In reading them one instinctively feels his thorough mastery of the subject under discussion, and also one realizes that any statement made by him is authoritative and does not require checking. But his influence extended far beyond his published contributions. All his associates are more or less indebted to him for suggestions, advice or help of one kind or another, and some of them at times leaned rather heavily upon him. His unusual capacity for detailed work and his accuracy went far toward maintaining the high standard of the various publications he edited.

Glover Morrill Allen was born in Walpole, New Hampshire, on February 8, 1879, the son of the Reverend Nathaniel Glover Allen and Harriet Ann (Schouler) Allen, a sister of Rear Admiral John Schouler, U. S. Navy. At a very early age he became interested in mammals and birds. He prepared for college at the Newton High School, and while living at Newton in the winter and at Intervale, New Hampshire, in the summer he busied himself with an intensive study of the local faunas. Even when in high school he had an enviable local reputation as an authority on birds and mammals, although because of his shyness and diffidence he was personally known to very few. An unusually keen observer, he had already acquired a remarkably extensive knowledge of the details of the habits of the mammals and birds of his region, and his ability to recognize birds, particularly the numerous warblers, by their notes was almost uncanny. Like all the young zoologists of that region at the time, he made frequent visits to the natural history establishment of Charles J. Maynard, who always spoke of him as a most promising boy.

While living in Newton he made a large collection of the local mammals, all the skins being beautifully prepared and accompanied by full data. This collection, which included a porcupine, perhaps the last to be captured in Newton, was later presented to the Newton High School. In 1896 when a junior in high school he was elected an associate of the American Ornithologists' Union.

Entering Harvard, he was elected to the Phi Beta Kappa in his junior year, and received his A.B. *magna cum laude* in 1901. While at Harvard, in addition to the more usual courses, he applied himself to the study of Russian, and in the evenings studied Danish. He was awarded a John Harvard scholarship. In the year of his graduation from Harvard he was appointed secretary, and also librarian and editor, of the Boston Society of Natural History. Also in 1901 he published, together with Reginald Heber Howe, Jr., "The Birds of Massachusetts," in the preparation of which he had done the major part of the work.

In 1903 he received his A.M. degree, and in the same year published his book on the "Birds of New Hampshire." His Ph.D. he received in 1904; in June of that year he published a "List of the Mammalia of New England," and in July his doctor's thesis on "The Heredity of Coat Color in Mice." His interest in genetics was maintained throughout his career, and

he was one of the few descriptive naturalists who was also versed in the experimental method and in the literature of contemporary biology, and was therefore enabled to apply the knowledge of one field in judging results in the other.

Always passionately fond of outdoor life and with an absorbing interest in the habits of birds and mammals, he had made many camping trips to various places, but especially to the White Mountains, an area he knew in minute detail. Now for the first time he had an opportunity to visit the tropics as a member of an expedition to the Bahamas.

In 1906 and 1907 he was a graduate student at Harvard, and in the latter year began working part time on the mammal collections of the Museum of Comparative Zoology. While he did most of the curatorial work of the department as well as carried on research it was not until 1924 when he retired as Secretary of the Boston Society of Natural History that he was appointed curator of mammals, a position which he held until his death. During 1906 and 1907 he was serving as editor of *The American Naturalist*, then published by Ginn and Company; this editorship came to an end when that journal was taken over by the Science Press in 1908. In the summer of 1906 he made a trip to Labrador with Dr. Charles Wendell Townsend, publishing a paper on the "Birds of Labrador," in cooperation with Dr. Townsend, in 1907. In 1909 he was a member of an expedition to British East Africa, and in 1910 he visited Grenada, British West Indies, making extensive collections in both regions. His monograph on *Solenodon paradoxus* appeared in 1910.

He was married on June 26, 1911, to Sarah Moody Cushing, who, with a daughter, Elizabeth Cushing (Mrs. Arthur Gilman), survives him.

He was a member of an expedition to the Sudan in 1912. In 1916 his monograph on the whalebone whales of New England was published. On the establishment of the American Society of Mammalogists in 1919 he became a charter member, and also a member of the board of directors, and in the same year he was elected president of the Nuttall Ornithological Club, succeeding William Brewster, a position he held until his death. He was elected a fellow of the American Ornithologists' Union in 1921.

He retired as secretary of the Boston Society of Natural History in 1924, and in the same year was appointed a lecturer in zoology at Harvard. His "Birds and their Attributes," a work remarkable for the vast amount of included information, was published in 1925. In 1926 he was a member of an expedition to the Belgian Congo and Liberia.

He was elected president of the American Society of Mammalogists in 1927, serving for two years. On his retirement as librarian of the Boston Society of Natural History in 1928 he was elected vice-president, a post he held for the remainder of his life. In 1928 he published, in cooperation with his old friend Gerrit S. Miller, "American Bats of the Genera *Myotis* and *Pizonyx*."

He was a member of an expedition to Brazil in 1929, and in 1931 visited Australia.

The American Ornithologists' Union in 1937 selected him as editor of *The Auk*, and in 1938 he was appointed associate professor of zoology at Harvard. It was in 1938 that he published the first volume of his great monograph on the mammals of China and Mongolia, the second volume appearing in 1940. In 1939 he published a check list of the mammals of Africa, and also a most excellent popular work on bats, creatures which had always been of special interest to him and on which he was the leading authority.

This brief review of Dr. Allen's career gives but a very imperfect idea of his industry and accomplishments, and of the confidence that others felt in him. He published many papers on birds and mammals, most of them in Cambridge and Boston, and contributed many excellent and kindly reviews of the work of others, particularly to *The Auk*. In recognition of his achievements a number of birds and mammals collected by him, particularly in Africa, have been named for him by his friends.

Dr. Allen's interests were by no means confined to birds and mammals. He had an extensive acquaintance with many other groups, particularly with their representatives in New England. This was not surprising in the case of other vertebrates, which are not numerously represented in New England, but to see him recognize certain rare insects in the field was surprising. Once in a bog at Essex he suddenly exclaimed, "There is *Bombus borealis*," and, sure enough, there was that rare little bumblebee flying about.

Personally, Dr. Allen was a man of the highest ethical type, one of that rare sort in whom you instinctively feel complete confidence. He was always courteous to every one, and always anxious to be of assistance in any way possible. He had a cheerful and equable disposition. He never became excited over anything, and if depressed he never showed it. Especially characteristic was a lively sense of humor. Frequently he would surprise one with a droll remark, or an unusual combination of words. For instance, a zoo to him was "a museum which is not yet dead." He was deeply religious, an Episcopalian, but this side of his nature he always kept strictly to himself. Always retiring and rather shy, he was particularly reticent about his personal affairs.

Dr. Allen's sudden death on February 14, 1942, came as a great shock to all who knew him, and to

all those who knew and admired his work—a much larger group than he, modest as he always was, ever suspected.

AUSTIN H. CLARK

DEATHS AND MEMORIALS

DR. JOHN ALEXANDER MCGEOCH, professor of psychology and head of the department at the State University of Iowa, died on March 3, at the age of forty-four years.

PERCY TRAIN, fossil and plant collector, died on February 3. He was sixty-six years old.

THE death is announced of Dr. Cornelis Winkler, formerly professor of neuropsychiatry at Amsterdam, at the age of eighty-six years.

"A BOOK of Tributes to Charles Bernard Jordan," dean of the School of Pharmacy of Purdue University from 1924 until his death in April, 1941, has been issued by the university. It gives a reproduction of the illuminated parchment presented to him in honor of his twenty-five years of service to the university. Dr. Jordan joined the staff of the university in 1910.

THE Institución Cultural Española in Buenos Aires has established a laboratory for histopathologic research in memory of Professor S. Ramón y Cajal to be directed by Professor Pío del Río Hortega of Buenos Aires with a staff of eight investigators. The institute will promote investigations on the histology of the nervous system, employing the technic of Cajal and his school.

SCIENTIFIC EVENTS

GRANTS-IN-AID OF THE AMERICAN COLLEGE OF DENTISTS

THE American College of Dentists, through its Research Committee, offers annually a limited number of Grants-in-Aid and Research Fellowships. Information relative to such funds can be obtained by addressing the chairman of the Research Committee of the American College of Dentists, Dr. A. L. Midgley, 1108 Union Trust Building, Providence, R. I.

Research grants are made for one year only and are available on July 1. All applications should be made on blanks supplied for the purpose and must be in the office of the chairman of the committee by December 1. Action on requests for funds is taken once annually at a special meeting held by the Research Committee in February.

At a meeting held on February 21 in Chicago, the sum of $3,200 was allocated as follows:

$1,200 to Dr. Wallace Armstrong, of the University of Minnesota, for the continuation of an investigation of the effect of a fluorine free diet on the teeth of experimental rats and the determination of the fluorine content of some human diets.

$250 to Dr. Morris Steggerda, of the Carnegie Institution of Washington, Cold Spring Harbor, New York, for an investigation of the relation between growth and the eruption of the teeth in whites, Negroes and Indians.

$500 to Dr. Michael F. Bates, Tufts College Dental School, Boston, for an investigation to test the theory that the histological structure of the teeth is an index of the health of the individual during the period of tooth development.

$750 to Drs. H. R. Hunt and C. A. Hoppert, Michigan State College, for the continuation of an investigation of inheritance factors in rat dental caries.

$500 to Dr. James Nuckolls, of the University of California Dental School, for the continuation of a study of the primary centers of lobular development, growth and calcification of the tooth.

THE PROFESSIONAL STATUS OF CHEMISTS

THE professional status of chemists has been upheld by the National Labor Relations Board in a decision which lays down the principle that professional employees should not be forced into a bargaining unit composed of a miscellaneous group of skilled and unskilled workers as well as professional employees. It was held that only a majority vote of the professional group itself can determine its desires on the issue of union representation.

Describing the decision as "momentous," Dr. Charles L. Parsons, secretary of the American Chemical Society, says in a report to members of the society:

> While the board in earlier decisions had granted professional employees the right to express their choice in the matter of bargaining units, the unanimous decision rendered in the matter of the Shell Development Company and the International Federation of Architects, Engineers, Chemists and Technicians, Case No. R-3245, goes further than any prior decision of the board in establishing the right of professionals to self-expression within their group.

The controversy was submitted to the board on petition of the Federation of Architects, Engineers, Chemists and Technicians to set up a bargaining unit composed of both professional and non-professional employees. A group of professional employees of the company employed in professional work intervened, contending that professional and non-professional employees should not be merged into one unit.

When the case came to the board for hearing,

> the issue was squarely presented as to whether a union, by reason of having signed up a certain number of employees in a particular plant, could reach out and corral an almost equally large number of employees who had no desire to have that particular union represent them and

arbitrarily exclude from its proposed unit numerous other employees whom it had been unable to interest in its scheme because their inclusion in any voting unit undoubtedly would mean the loss of an election.

The board disposed of the union's contention by ordering two elections and designating two units for the purpose of the elections. The one unit is composed of all the skilled and unskilled employees in the plant. The other unit is composed of all the professional workers in the plant. Department heads and supervisory employees were excluded from the vote. In thus resolving the issue as it did the board afforded the professional employees an opportunity to express themselves in a group composed entirely of professional employees on the question of union representation for collective bargaining.

THE REMOVAL OF THE NATIONAL PARK SERVICE FROM WASHINGTON

BY order of the Federal Budget Director issued on December 19, the National Park Service and two other bureaus of the Department of the Interior were directed to move their Washington offices to Chicago. The transfer of these and other federal agencies to make room for rapidly increasing defense workers has been opposed on various grounds.

Many of the agencies themselves have reported to the Congress that it would seriously disrupt their operations to move their main offices to distant locations. Appearing by request before a joint session of the Senate and House District Committees on January 9, Director Newton B. Drury testified that the National Park Service is already highly decentralized, with 5,263 employees in the field and (besides 533 with National Capital Parks) only 304 in Washington. He said that the service has many close relationships with other federal bureaus at the seat of government which are necessary for the efficient conduct of its affairs. He pointed out that the service has not only made many direct contributions to the defense program, but has suggested numerous alternatives to the War and Navy Departments for saving distinctive areas from uses that would cause irreparable damage. Fifty per cent. of the Washington office employees have indicated that they can not move to Chicago.

Congressional opponents of further decentralization gave up their fight to hold federal bureaus in Washington on January 14, when the Senate by a vote of 33 to 26 defeated a resolution calling for a report to the Congress on the government's removal plans. President Roosevelt has asserted that the transfer orders will not be revoked, but the Bureau of the Budget has already made some modifications of its original plans. Current studies are being made by the National Park Service to determine the possibility of further decentralizing its activities, so that the complete transfer of its Washington office to Chicago would be unnecessary.

If the National Park Service is moved away from Washington "for the duration," leaving only a small liaison unit to handle contacts with the Congress and other agencies, friends of the National Parks hope that under no circumstances will this move be made permanent, because the public interest would be ill-served by such an eventuality. During the absence of the service it will be more important than ever to have such a disinterested organization as the National Parks Association on the job in Washington, where it can remain alert to the recurring dangers of encroachment on the National Parks and related areas.

THE MEDICAL ADMINISTRATION CORPS OF THE ARMY

ACCORDING to the *New York Times*, Colonel Leonard G. Roundtree, medical director of the Selective Service Board, in an address in Chicago at the annual meeting of the National Conference on Medical Service reported that "the Surgeon General of the Army has ruled that not only will the Army commission third- and fourth-year medical students as second lieutenants, but also first- and second-year medical students and pre-medical students of acceptable standing. They will be assigned to the Medical Administration Corps of the Army."

He explained that the students so commissioned would be in the Army Reserve and would not be called into active service until they had finished their education.

Dr. Morris Fishbein, editor of the *Journal* of the American Medical Association, said that a similar program has been adopted in the Navy.

As reserve officers the students will be draft-proof. Heretofore, only the third- and fourth-year students and internes were accepted for commissions.

The ruling by Major General James Magee, Surgeon General of the Army, according to the *Times*, was in answer to warnings from members of the medical profession that a shortage of physicians would arise unless some uniform method of providing deferment for medical students was found.

About 12,000 pre-medical students apply for medical school entry each year, according to Dr. Fishbein, and about 6,500 are chosen. Dr. Fishbein said that the Army's ruling would apply only to those chosen and emphasized that at the first sign of a student's inability to handle the work he could be made eligible for the draft. He pointed out that this not only insures the Army and Navy of a plentiful supply of physicians, but will insure that civilian needs will not suffer.

APPOINTMENTS OF THE OFFICE OF CIVILIAN DEFENSE

THE following appointments in the Office of Civilian Defense have been announced:

Dr. John S. Coulter, associate professor of physical therapy, Northwestern University Medical School, has been appointed Regional Medical Officer of the Sixth Civilian Defense Region, with headquarters in Chicago.

Dr. Dudley A. Reekie, assistant director of health and chief medical officer of the Tennessee Valley Authority, has been appointed Regional Medical Officer of the First Civilian Defense Region, with headquarters in Boston. He succeeds Dr. Allan M. Butler, Boston, who resigned to become head of the department of pediatrics at the Massachusetts General Hospital, Boston. Dr. Reekie entered on active duty on January 31.

Dr. Leonard A. Scheele, passed assistant surgeon, U. S. Public Health Service, Bethesda, Md., was recently assigned to the Washington staff of the Medical Division, Office of Civilian Defense. Dr. Scheele graduated from Wayne University College of Medicine, Detroit, 1933, and was commissioned in the public health service following the completion of his internship. Dr. Scheele was assigned in 1938 to the National Cancer Institute, Bethesda, as consultant on cancer control. There he conducted studies of the epidemiology of cancer, efficacy of cancer therapy, radiation protection and cost of cancer therapy.

Dr. Harold Marks, passed assistant surgeon (Reserve), U. S. Public Health Service, recently on the staff of the National Institute of Health, Bethesda, joined the Medical Division staff in January. Before being assigned to the Office of Civilian Defense, he was stationed at the National Institute of Health and was engaged in making surveys of medical care in defense communities.

William H. Carey, Jr., recently associated with the Norman Boosey Manufacturing Company, Detroit, has been appointed Regional Sanitary Engineer for the Sixth and Seventh Civilian Defense Regions, plus Indiana and Kentucky, with headquarters in Chicago, effective February 4. He has been commissioned Sanitary Engineer (Reserve) in the U. S. Public Health Service.

APPOINTMENT OF CAPTAIN N. H. HECK

REAR ADMIRAL L. O. COLBERT, director of the U. S. Coast and Geodetic Survey, announces that Captain N. H. Heck, formerly chief of the Division of Geomagnetism and Seismology of the Survey, has been appointed assistant to the director on scientific and technical matters. Captain Heck is well known in scientific circles as one of the world's leading authorities on earthquakes and the earth's magnetic forces.

Captain Heck entered the survey in 1904. He served at sea for a number of years and at various times commanded the survey ships *Hydrographer, Matchless* and *Explorer.* He had a large share in the development of the wire drag, which has been responsible for the discovery and charting, or ultimate elimination, of countless menaces to navigation. He also contributed materially to the early development of the Radio Acoustic Ranging method of hydrographic surveying.

His interest turning to research in magnetism he became, in 1921, chief of the Division of Terrestrial Magnetism. When the study of earthquakes was transferred from the Weather Bureau to the Coast and Geodetic Survey in 1926, his title was changed to chief of the Division of Terrestrial Magnetism and Seismology, in which capacity he served until he assumed his new work.

He is author of numerous books and articles on scientific and technical subjects. Among his works are: "Earthquakes," published in 1936; "Compensation of the Magnetic Compass," 1923; "Velocity of Sound in Sea Water," 1924; and "Earthquake History of the United States," 1928 and 1938. He has been the recipient of several honorary degrees and is a member of a number of scientific and engineering societies. From 1935 to 1938 he was chairman of the American Geophysical Union, and from 1936 to 1939 president of the Seismological Association of the International Geodetic and Geophysical Union. He is a past president of the Philosophical Society of Washington and of the District of Columbia Chapter of Sigma Xi.

SCIENTIFIC NOTES AND NEWS

THE William H. Nichols Medal of the New York Section of the American Chemical Society was presented to Dr. Duncan A. MacInnes, of the Rockefeller Institute for Medical Research, for "distinguished contributions to electrochemistry" at a dinner of the section in New York City on the evening of February 27. The presentation was made by Professor William C. MacTavish, head of the department of chemistry of New York University and chairman of the jury of award, which cited Dr. MacInnes for "outstanding investigations on electrolytes and the development of techniques which have immeasurably enriched both the theory and practice of modern electrochemistry." In his acceptance speech, Dr. MacInnes discussed "Galvanic Cells as Instruments of Research." Professor Herbert S. Harned, of Yale University, spoke on "The Work of the Medalist," and Professor George Scatchard, of the Massachusetts Institute of Technology, on "Dr. MacInnes—The Man." Professor Ralph H. Müller, of New York University, chairman of the section, presided.

THE 1941 Lamme Medal of the American Institute of Electrical Engineers has been awarded to Forrest E. Ricketts, vice-president of the Consolidated Gas, Electric Light and Power Company, Baltimore, "for his contribution to the high reliability of power-supply systems, especially in the design of apparatus for selective relaying and circuit reclosure." The medal

and certificate will be presented to him at the annual summer convention of the institute, which will be held in Chicago from June 22 to 26.

THE award of the Wollaston Medal of the Geological Society of London to Dr. Reginald A. Daly was announced in SCIENCE last week. The following awards have also been made: The *Murchison Medal* to Professor H. H. Swinnerton, professor of geology at University College, Nottingham, for his "stimulating contributions to the philosophy of paleontology"; the *Lyell Medal* to W. S. Bisat, for "studies in the stratigraphical paleontology of Carboniferous rocks"; the *Wollaston Fund* to Dr. E. S. Hills, for "contributions to Australian paleontology and geology"; the *Murchison Fund* to Dr. K. C. Dunham, for "investigations into the mineral deposits of the North of England"; a moiety of the *Lyell Fund* to Dr. S. R. Nockolds, for "mineralogical and petrological work and his contributions to the study of assimilation processes"; a second moiety of the *Lyell Fund* to Dr. J. Shirley, for "researches in paleozoic paleontology and stratigraphy."

THE William Mackenzie Medal of the University of Glasgow has been awarded to Dr. A. J. Ballantyne, formerly professor of ophthalmology, in recognition of his work in the ophthalmological branch of medicine and surgery. It is expected that Dr. Ballantyne will give in May the customary address before the section of ophthalmology of the Royal Society of Medicine.

Nature states that the Platinum Medal of the Institute of Metals for 1942 has been awarded to W. Murray Morrison, vice-chairman and managing director of the British Aluminium Company, "in recognition of his outstanding services to the non-ferrous metals industries."

THE *Journal* of the American Medical Association reports that the New York Chapter of the National Gastroenterological Association held a special meeting on January 19 to mark the eightieth birthday of Dr. Max Einhorn, emeritus professor of medicine, New York Post-Graduate Medical School, Columbia University. The Rudolf Virchow Medical Society observed his birthday on January 5. He was given a testimonial dinner on January 10 by the staff of the Lenox Hill Hospital, with which he has been associated for more than fifty years.

DR. S. A. HENRY has been appointed by the Royal College of Physicians, London, to be Milroy lecturer for 1943. The subject of the lecture has been announced as "The Health of the Factory Worker in War Time."

ACCORDING to *Nature*, the following officers of the Iron and Steel Institute have recently been elected: *President*, James Henderson; *Vice-president*, Dr. Andrew McCance; *Hon. Treasurer*, The Hon. R. G. Lyttelton; *Members of Council*, Professor J. H. Andrew and N. H. Rollason. Walter S. Tower, president of the American Iron and Steel Institute, has been nominated an honorary member of the institute, and the presidents of the Sheffield Society of Engineers and Metallurgists and of the Sheffield Metallurgical Association have been appointed honorary members of the council.

DR. EVERETT NEEDHAM CASE, Van Hornesville, N. Y., assistant dean of the Harvard Graduate School of Business Administration, has been elected the ninth president of Colgate University to succeed President George Barton Cutten, who is retiring after serving for twenty years. Mr. Case will take up his work at Colgate University on August 31.

DR. W. W. CHARTERS, since 1928 director of the Bureau of Educational Research of the Ohio State University, will retire from active work next August. He plans to devote his time to writing.

DR. LUCIUS F. BADGER, surgeon, U. S. Public Health Service, Washington, D. C., has become assistant director of the National Institute of Health, Bethesda, Md.

DR. ROBERT R. WILLIAMS, chemical director of the Bell Telephone Laboratories of New York, has been elected a member of the board of directors of the American Bureau for Medical Aid to China.

DR. GEORGE C. DUNHAM, director of the laboratories of the Army Medical School, Washington, and from 1931 to 1935 technical adviser to the Governor General of the Philippine Islands, has been appointed director of a new division of health and sanitation in the Bureau of Inter-American Affairs, of which Nelson A. Rockefeller is coordinator. Dr. Dunham will be placed at the head of a mission which is going to Ecuador to undertake malaria control, improvement of sewage disposal and other modern sanitation measures in cooperation with the Ecuadorean government. Members of the mission include Dr. Walter C. Earle, specialist on tropical medicine, of the International Health Division of the Rockefeller Foundation, and Wyman Stone, a sanitary engineer.

ACCORDING to *Chemical and Engineering News*, Swift and Company, Chicago, has made a grant to be used under the direction of Dr. Ancel Keys, of the University of Minnesota, in a study of the relation of fatigue to diet. This work was originally sponsored by the National Research Council and is now operating under the Office of Scientific Research and Development in direct cooperation with the United

States Army Quartermaster Corps. Although much of this work is being directly applied to military and industrial needs during the present emergency, it will be possible to extend the findings to civilian nutrition.

AN award of $1,000 has been made by the Borden Company to Irvington House, Irvington, to assist in its study and treatment of rheumatic fever. The researches are under the direction of Dr. Ann G. Kuttner, Irvington, resident medical director, with the guidance of a medical advisory board, of which Dr. John Murray Steele, New York, is director.

DR. B. E. DAHLGREN, chief curator of the department of botany of Field Museum, Chicago, is spending several weeks in various parts of Cuba, making a survey of the palms of that island, in order to obtain specimens of important species required to fill out the exhibits of palms at the museum.

DR. L. T. DEVORE, assistant professor of physics at Pennsylvania State College, has leave of absence to accept a call from the War Department for service as a radio engineer at the Aircraft Laboratory, Wright Field.

DR. ALBERT R. BEHNKE, Lieutenant Commander, Medical Corps, U. S. Navy, instructor in charge of department of atmospheric hygiene, Navy Yard, will deliver the sixth Harvey Society Lecture of the current series at the New York Academy of Medicine on March 19. He will speak on "Physiologic Studies Pertaining to Aviation Medicine and Deep Sea Diving."

DR. JOSEPH A. PEARCE, director of the Dominion Astrophysical Observatory, Victoria, British Columbia, delivered an illustrated lecture entitled "The Rotation of the Galaxy," at the University of California at Los Angeles on March 2. The lecture was given under the auspices of the Department of Astronomy.

DAVID BRUCE DILL, director of the fatigue laboratory, Harvard University, and Dr. Arlie V. Bock, Henry K. Oliver professor of hygiene, will deliver the James M. Anders Lecture before the College of Physicians of Philadelphia on April 1.

THE twenty-fifth annual meeting of the American Society of Ichthyologists and Herpetologists will be held in New York City from Tuesday, March 31, to Saturday, April 4. The business meeting and formal sessions will be at the American Museum of Natural History. Visits to the New York Zoological Park and to the Staten Island Zoological Park will be made. The annual banquet will be held at the American Museum of Natural History on Wednesday evening at 8 P.M. A joint smoker, with the American Society of Mammalogists, on the evening of Thursday is being sponsored by the New York Academy of Sciences. Two symposia are planned. The first, for mammalogists and ornithologists, on "Criteria for Vertebrate Subspecies, Species and Genera," will be formally conducted as a joint meeting with the American Society of Mammalogists. The subject of the second symposium for ichthyologists and herpetologists will be "Vertical Distributions."

THE American Association of Industrial Physicians and Surgeons and the American Industrial Hygiene Association will meet in Cincinnati from April 13 to 17. The meeting will open with medical and surgical clinics at the Cincinnati General Hospital together with a conference on skin affections, the most common cause of occupational disease claims in industry. The second day's session will give attention to the health of industrial executives, including a consideration of heart disorders. The third day will be devoted largely to a symposium on lead poisoning. Subjects scheduled for the fourth day include Solvent-Vapor Poisoning, Ventilation of Deep Tunnel Operations and Safe Handling of Magnesium Castings. The final sessions on April 17 will cover proper prevention of tellurium fumes and other health threats, like lead chromate, encountered in metal industries.

A MEETING, sponsored by the New York branch of the American Association of Scientific Workers, on "The Scientist's Role in Civilian Defense, War Research and Education" was held on March 11 at Columbia University. The meeting included discussion of a recent survey by the association to find the extent of participation in the war effort of scientific men. Representatives from the American Chemical Society, the Office of Scientific Research Development and other organizations attended and contributed to the discussions.

THE Inter-American Chemists Congress, which was to be held at Santiago de Chile in January, 1942, probably will be held during the third week in September. The secretary of the organizing commission is Juan Hepp D., Casilla 3725, Santiago de Chile, from whom further information can be obtained.

SEVEN national library associations, working through their Joint Committee on Importations, have been engaged since October, 1939, on the problems involved in the importation of library materials in time of war. The committee has succeeded in completing negotiations which will make possible the importation during 1942 of a limited number of copies of scientific and technical periodicals and continuations from all countries of Europe, except Russia, Sweden, Switzerland, Spain and Portugal. Any responsible library may apply before March 30 for participation in the plan. Information may be obtained from the chairman of

the committee, Thomas P. Fleming, medical librarian, College of Physicians and Surgeons, New York, N. Y.

APPLICATIONS for grants from the Cyrus M. Warren Fund of the American Academy of Arts and Sciences should be received by the chairman of the committee, Professor Frederick G. Keyes, of the Massachusetts Institute of Technology, not later than April 15. Grants are made in aid of chemical research, generally for apparatus or supplies, or for the construction of special facilities needed for research in chemistry or in fields closely related to chemistry. Grants are not awarded for salaries, and on account of limited resources, the amount to an individual is seldom in excess of $300. Application blanks may be obtained from the chairman upon request.

THE New York Hospital School of Nursing has become a part of Cornell University in an affiliation whereby qualified graduates will receive a university degree. Together with the New York Hospital and Cornell University Medical College, the School of Nursing is a unit in the medical center at 68th Street. It will be known as the "Cornell University-New York Hospital School of Nursing." The curriculum includes classroom study and practical experience in the New York Hospital. Students entering with two or more years of college work acceptable to Cornell University will be eligible for a degree of bachelor of science in nursing upon satisfactory completion of the three-year course.

AMONG the public bequests of the late Sir Arthur William Hill, director of the Royal Botanic Gardens at Kew, are £1,000 to Bentham-Moxon Trustees of the Royal Botanic Gardens; his diaries of various journeys are left to the library of the gardens; £500 to Kew Guild; £1,000 to the Royal Society; £500 to the endowment fund of St. Luke's, Kew Gardens, and, after personal bequests, of the residue, one eighth to King's College, Cambridge, and one eighth to Marlborough College. The value of the estate is placed at £93,379.

DISCUSSION

ON THE READING OF SCIENTIFIC PAPERS.

AUDIENCE ENEMIES NUMBERS I TO VI

A FEW years ago a large international congress was held in one of the most beautiful cities of Europe. The committee on arrangements had planned every detail to perfection. The university buildings were new, the lecture halls ample. Each platform was provided with a two-foot clock that not only pointed out the elapsed time but also turned on a red light at eight minutes and a big flashing light at ten minutes. When the meeting started, one could say "Every prospect pleases."

Only man was vile. One hour after the opening members realized that the distinguished chairmen of the sections were not holding the speakers to the ten-minute limit so carefully stipulated in the programs. Therefore, every speaker counted on talking fifteen or twenty minutes. Of course he saved his most important slides until the end and they were shown in competition with the flashing light plus an obviously nervous chairman.

In addition, there were all the other minor and major human defects best calculated to torture an audience. Most of the speakers mumbled their words or else turned and lectured to the lantern screen. This was particularly annoying, since the papers were delivered in four different languages, each with its local variants. Most of the lantern slides were photographs of typewritten sheets crowded with data, and few speakers were content to show less than twenty. The main points were carefully concealed until the last minutes, by which time the audience had lost all interest.

This meeting was perhaps an extreme example, and in our country most of the papers are carefully prepared and carefully delivered. There are, however, enough poorly delivered papers to warrant a discussion of what may be called "audience enemies":

1. The Mumbler, who drops his voice to emphasize important points or else talks to the lantern screen instead of to the audience.
2. The Slide Crowder, who packs his slides with typewritten data and shows too many slides.
3. The Time Ignorer, who talks beyond the limit specified in the program or justified by common courtesy.
4. The Sloppy Arranger, who jumbles his material.
5. The Lean Producer, who has poor material.
6. The Grasping Discussor, who when he gets talking stays talking.

Of course there are many other ways in which a speaker may cause discomfort, but the ones that I have selected are chosen because they can be remedied either by the head of the department or by strict self-examination.

Number 1, the Mumbler, is handicapped by poor habits of speech, an incorrectly placed voice or else an inherent nervousness. In other cases bad delivery is caused by lack of consideration in a man who is more interested in excreting words than in conveying information. When he turns to the screen and talks at the chart he is paying more attention to his own achievements than to the audience. This is particu-

larly disastrous if he wanders away from the microphone.

Number 2, the Slide Crowder, wishes to show just as much of his data as possible and thus demonstrate his industry. He prepares many slides from typewritten sheets, because this is the easiest method. He ignores the fact that the typewriter has the worst possible type for display at a distance. Has any one ever seen such type used on advertising bill-boards? If he would only have his slides drawn with india ink the very labor involved would cause him to limit his material to the essentials, and these would be legible. It is a simple matter to calculate for a ten-minute paper just how many seconds each slide will be exposed on the screen and how much can be read and understood while thus exposed. Every nonessential word or figure distracts the eye from the small fraction that is essential. A good slide needs no pointer or verbal explanation.

The ideal method of competing with a slide is to employ one of the modern flashlights with a bright arrow that dances all over the screen and ceiling. There is nothing in black and white that has a chance of holding the eye when a bright arrow swoops and darts like a hornet.

Number 3, the Time Ignorer, who exceeds the limit set by the program is purely selfish or else overimpressed with the idea that his paper is much more important than the program committee had imagined. He may have planned deliberately to go overtime but more probably did not take the trouble to rehearse his paper with a watch. If he did use a watch he forgot that it always takes several minutes longer to deliver a paper from a platform than to read it in an empty room.

Number 4, the Sloppy Arranger, selects the method of presentation best calculated to confuse the audience. He may have in the back of his head the idea that he can lead up to a climax and hold the audience in breathless suspense until in the very last sentence he can prove that the venous blood of the wimpus contains only 3 milligrams of gadgetyl chloride instead of 4 milligrams. Would it not be kinder to the audience if he followed newspaper technic and gave in a headline, early in the talk, some idea as to what and wherefore?

Number 5, the Lean Producer, is only relatively lean. If he has one fact to exhibit and does it modestly he has made a contribution. If he does not recognize his paucity of material he does more harm than good. The real audience enemy is the man whose paper consists of trivia, errata, omissia, et cetera; mostly et cetera.

Number 6, the Grasping Discussor, can spoil almost any meeting. If he has been invited to open the discussion he has probably prepared a nice little paper of his own with scant reference to the paper of the evening. There is another type of discussor who happens to have in his pocket some lantern slides that he would just like to show for two minutes.

In the face of all these enemies the audience itself can do but little. The chairman, however, can do a great deal. Perhaps instead of chairman he should have the title of "Sole Protector of the Audience." If he has established a reputation for keeping people within their time limits they will take the trouble to arrange their material and lantern slides and bring out their main points in a decent manner. The faults of poor delivery, poor slides and poor material are the responsibility of the head of the department. He should guard the reputation of his institution. Unfortunately, some heads of departments exhibit in their own deliveries many of the faults enumerated.

The time to start training is when a man is young. In one medical school this has been tried successfully with the fourth-year students taking their clerkship in the medical dispensary. Every Saturday morning a group of clinical clerks have gathered to hear four fifteen-minute papers delivered by members of their class. The students have been warned that the papers are limited strictly to fifteen minutes and that in rehearsal they must not take more than twelve minutes. They are advised to talk to the men in the back of the room, since these are the most difficult to keep interested. They are taught that time spent in listening to a dull lecture, poorly delivered, is not wasted if they study the faults of the speaker and consider the methods by which they may be avoided. In a few sessions they develop a technic of delivery that is much better than the average found at scientific meetings. This allows the speakers and the audience to forget the delivery and concentrate on the subject-matter.

The man who goes overtime, uses crowded slides and mumbles his words is seldom more than 50 per cent. audience enemy. If his paper comes in the middle of the session it does not affect the first half of the program, even though he talks far beyond his limit. If his slides are crowded, half of the material can be read by the front half of the room. The same front half can usually hear him, even thought he mumbles his words. He would not dream of saying, "The public be damned." He just damns the rear half.

EUGENE F. DUBOIS

DEPARTMENT OF PHYSIOLOGY,
CORNELL UNIVERSITY MEDICAL COLLEGE,
NEW YORK

ON A SYSTEM OF FILING REPRINTS

THE system of Professor McClung[1] for filing reprints seems to us rather interesting. We would like

[1] L. S. McClung, SCIENCE, 95: 122–123.

to suggest another one that is in use in the Division of Agronomy and Genetics at the University of Minnesota. This system originated with Professor H. K. Hayes. We found it extremely useful for our own work and for graduate students while teaching at the university during the fall quarter of 1941.

The system in use at Minnesota is very simple. Reprints are filed in reprint boxes that are large enough to take typed or mimeographed reports ($8\frac{1}{2}'' \times 11''$). Each reprint is numbered (in consecutive order) and there is an index card for the subject-matter and also one for the author. These index cards are filed, one set for authors and another for subject-matter. As new reprints are received they are numbered and cross indexed on standard 3×5 library cards. Reprints are then filed in the boxes which are arranged on the shelves in numerical order. Since each box is full there is no trouble with reprints becoming doubled up as they do in partially filled boxes. There is never any problem of where to file reprints, and it is always easy to locate any reprint by subject or author.

We found this system much more practical than the system generally used where the reprints are filed alphabetically according to authors. Where graduate students are using the reprints it is important to have them well indexed both by subject and author.

Single unbound copies of several biological journals are also filed like reprints. Although there is a greater chance of losing some number of a journal the fact that the single issues are filed makes them available to a greater number of students at any one time. Any possible loss of single numbers is more than offset by the greater good derived by more students using the journals. Both reprints and single copies of the journals are signed out by students using them.

This way of handling reprints and journals seems to us very simple and practical. The important thing is that it works, and the reprints and journals are used extensively by the graduate students in the Division of Agronomy and Genetics.

W. RALPH SINGLETON
CONNECTICUT AGRICULTURAL EXPERIMENT STATION,
NEW HAVEN

THE STATUS OF EXPERIMENTAL PSYCHOLOGY AT THE UNIVERSITY OF MISSOURI

IN a recent report on "The Status of Experimental Psychology among the Laboratory Sciences,"[1] the University of Missouri was included in a list of institutions which require laboratory science for the A.B. degree in the college of Arts and Science, but which do not accept experimental psychology in fulfilment of this requirement. In 1937, when the data for this report were obtained, this was true. In the academic year 1939–40, however, the Department of Psychology at the University of Missouri instituted a 5-semester-hour beginning course in general experimental psychology, which is now offered in addition to the usual 3-hour course in general psychology. Students may meet the biological science requirement for the A.B. degree in the College of Arts and Science by taking general botany, general experimental psychology or general zoology.

The catalogue describes the course in general experimental psychology as dealing with "the basic facts, principles, and methods of psychological science, with special reference to the human being," and as consisting of "lectures, classroom demonstrations, and laboratory experiments." There are three lectures and two 2-hour laboratory sessions each week. The course is taught from an experimental biological point of view with emphasis on experimental procedure and scientific attitude.

The course in general psychology, on the other hand, includes no laboratory work and emphasizes to a lesser degree the biological aspects of human behavior. It meets no specific requirements for graduation, but it may be substituted for general experimental psychology as satisfying the prerequisite for more advanced courses in the department.

FREDERICK A. COURTS
UNIVERSITY OF MISSOURI

[1] J. E. Winter, SCIENCE, 95: 96–97, 1942.

A NOTE ON "STOMATES"

MUCH as I sympathize with Dr. White's[1] protest against such unnecessary words as "stomates," it is only fair to point out that the word is not, as he seems to imply, etymologically badly formed. It is not comparable to "eggses." The Greek word is στοματ (stomat); the final consonant was dropped in the nominative singular for euphony, but appears in other cases, such as the genitive singular (stomatos). The Anglicization "stomate" is correct. Nor is the word really unwieldy; "stomates" is just as easy to say as "stomas."

Many of the more ludicrous efforts of biologists to bestow names upon their mental progeny betray the results of unfamiliarity with languages. It behooves us all the more to invoke some philological accuracy in criticizing them.

H. W. RICKETT
THE NEW YORK BOTANICAL GARDEN

CEMENT AS A FIRE EXTINGUISHER

IN the January twenty-third issue of SCIENCE there is a short article on the use of pitch as the best incendiary extinguisher, by Dr. R. Sayres, director of the U. S. Bureau of Mines.

[1] See SCIENCE, 95: 171, February 13, 1942.

It would seem to the writer that a good deal of caution must be used in the application of pitch to extinguish fire, even though it originates from a magnesium incendiary bomb. It has been the experience of the writer with a great variety of small fires in oil, metals and other materials, there is nothing so satisfactory and so foolproof as Portland cement as it is placed on the market. In many cases in the writer's experience it has been highly successful in extinguishing fires where water, carbon tetrachloride, foam and similar substances have been unsuccessful. This very common material so easily available and so safe to use should be placed at points where there is danger from fires either from incendiary bombs or from normal causes.

In our own laboratory, we provide such material easily available in kegs and find it far more successful than the usual fire extinguishers. Furthermore, it gives off no injurious gases and is in itself not combustible, as in the case of pitch.

ROY CROSS
KANSAS CITY TESTING LABORATORY

SCIENTIFIC BOOKS

CELESTIAL MECHANICS

The Analytical Foundations of Celestial Mechanics. By AUREL WINTNER. xii + 448 pages. Princeton University Press. 1941.

THE author states explicitly in the preface that the title of this volume is meant to imply that the general topological methods initiated by Poincaré are not discussed. For instance, virtually nothing is said of surfaces of section. Nevertheless, the author does find occasion to state (without proof) both the recurrence theorem of Poincaré and the ergodic theorem of Birkhoff, though not the mean ergodic theorem first proved by von Neumann. Also there are some well-chosen omissions from the purely analytical aspects of the subject: for example, the proofs of Bruns and Poincaré on the non-existence of integrals of certain types in the problem of three bodies. By making omissions of this kind the author has succeeded in isolating a well-rounded portion of celestial mechanics to which he has given an exceptionally thorough and scholarly treatment.

The first chapter opens with an explanation of the matrix and vector notation, which is used to advantage in many parts of the book for the sake of brevity, but which does not, in the opinion of the reviewer, add to the clarity of the exposition save in very exceptional cases: say, in the treatment of characteristic exponents in the following chapter. The first chapter, without actually mentioning the differential equations of Lagrange or Hamilton, introduces the idea of a "Lagrangian derivative" and gives an account of various mathematical formalities connected with the underlying group of canonical transformations. Certain special transformations are also treated: namely, rotations and the conformal transformations used later in connection with systems of two degrees of freedom.

In the second chapter are introduced the (conservative holonomic) dynamical equations with their Jacobi differential equations of variation. It is incidentally proved in this chapter (from the transversality conditions of the calculus of variations) that in a family of periodic solutions, in which the period is a function of class C' of the parameters, the period must be a single valued function of the energy alone. This interesting result, though well known and discovered independently by a number of mathematicians, has not previously (to the reviewer's knowledge) been published in any general treatise on dynamics. It is also in this chapter that mention is made of the ergodic theorem and that stability and characteristic exponents are discussed.

In the third chapter use is made for the first time of the hypothesis that the Lagrangian function is a quadratic polynomial in the velocities and that the purely quadratic part is positive definite. Various results are proved on the assumption that the coefficients of this polynomial are homogeneous of various degrees in the coordinates of the configuration space. Here also is presented the principle of least action and the closely related question of iso-energetic transformation. Systems with one and two degrees of freedom and systems with radial symmetry are considered in some detail.

In the fourth chapter we have a very extensive treatment of the problem of two bodies. Just because the derivation of the equations of planetary orbits from Newton's law of gravitation is a standard topic in elementary mechanics, we sometimes forget that the derivation of the coordinates as explicit functions of the time is by no means easy and indeed has been the subject of numerous classical investigations, leading, for instance, to the discovery of Bessel functions. Here the expansions connected with Kepler's equation are given an elaborate treatment. The problem is also considered with respect to a coordinate system rotating with uniform angular velocity about the center of gravity. This is a necessary preliminary to the systematic study of the restricted problem of three bodies.

The fifth chapter is largely an exposition of Sundman's work on the problem of n bodies (with special emphasis on the case $n = 3$). There is, of course, much about the Sundman theory which is intuitively evident

Thus, in a motion in which r of the n bodies collide at $=0$, one would expect the motion of the r colliding odies to be relatively only slightly affected for numer-ally small values of t by the $n-r$ bodies which do not artake in the collision. Thus, for example, the heory of binary collisions is closely dominated by the heory of straight line motion of only two bodies, and undman's famous regularization of a binary collision almost obvious. Even when the rigorous proofs are omplicated (involving such things as Tauberian con-itions), the theory is usually well motivated. A fun-amental and deep result in this connection is to the ffect that when all n bodies collide, the configuration ltimately becomes very close to a "central configura-ion." Hence a necessary preliminary for further rogress (of certain kinds) in the n body problem is detailed study of the central configurations and the losely related homographic solutions. Such a study here given.

Also given in this chapter is a new explicit reduc-ion of the problem of three bodies to a system of rder 8, using the integrals of linear and angular omentum; or to a system of order 6, with use of the nergy integral and elimination of the time. The co-rdinates used in the system of order 8 are, roughly peaking, the three mutual distances and the angle be-ween the invariable plane and the plane of the three odies. If there is no invariable plane, the motion kes place in a plane anyway, and it is this plane hich is used instead of the invariable plane.

The last chapter is devoted to the restricted problem three bodies with special reference to the limiting se considered by Hill in connection with the motion the moon. Hill was able to compute numerically to high degree of accuracy the coordinates of a one arameter family of periodic motions as functions of e time and period. The exact solution of this prob-m involves the solution of an infinite system of non-near equations, the appropriate existence theorems which were first proved by Wintner some fifty ears after the completion of Hill's calculations. This probably the most important original contribution the author, which is now published in a general reatise for the first time together with an account of Hill's original computations.

Other topics discussed in chapter VI are: regulari-ation, the location and character of the critical points the potential functions $\frac{1}{2}(x^2+y^2)+(1-\mu)[(x-\mu)^2+y^2]^{-\frac{1}{2}}+[(x-\mu+1)^2+y^2]^{-\frac{1}{2}}$ and $\frac{3}{2}x^2+(x^2+y^2)^{-\frac{1}{2}}$, and e non-planar restricted problem of three bodies. he book closes with a few general remarks about the ivergent series of dynamics.

DANIEL C. LEWIS, JR.
UNIVERSITY OF NEW HAMPSHIRE

PHYSICS

Physics. By W. F. G. SWANN, D.Sc., director of the Bartol Research Foundation, the Franklin Institute of Pennsylvania; with the assistance of Ira M. Freeman, Ph.D., associate professor of physics, Central College, Chicago. New York: John Wiley and Sons, Inc.

THIS book is one of a series under the general title of THE SCIENCES, which in the words of the general editor, Professor Gerald Wendt, Ph.D., provides "a brief but significant survey of the fundamental sciences, an elementary but sound foundation for the further study, but above all a key to the understanding of our environment and of the possibilities inherent in science." The editor's choice of an author of the book on physics was a very happy one. Dr. Swann is eminently qualified for the task. His occupation as a director of research has freed him from the habit-forming routine of the classroom, and he has been able to write a book which is easy to read, full of information and devoid of pedantry. He ventures "to utter the heresy that the *ideas* are more important than the *facts*," and in his presentation of the subject he emphasizes the ideas. He gives no irrelevant facts and avoids mathematical formulas and argument.

After a brief introduction on the scope and purpose of physics, the book takes up the subject of Dynamics, treated by "a general discussion in which the methods of thought employed in this science are established," in which besides the conventional subjects of force and mechanical energy, we find a section on vibrations, an account of the relations of heat and energy and a sketch of the kinetic theory of matter and of thermodynamics. Then follow chapters on the main divisions of physics, presenting mechanics and heat again and going on in the usual order to the end. It may be noted as unusual in such presentations that we find an account of the development of the tempered scale of the piano, and a long—in proportion—description of lens optics. The story closes abruptly with electromagnetic induction. The concepts of the electron and the proton are used in the discussion of electrostatics and of electrodynamics as well, and it is hard to see why such important parts of physics as the electric discharge in rarefied gases and radioactivity have been omitted. I hope that the author is holding them back to serve as the introduction to another book in which he will present the new philosophy of physics which has grown up in recent years, in which "the revolutionary nature of the ideas involved is so great that our grandfathers would have required a lifetime to become accustomed to the implications of even a part of them." Dr. Swann would do this work admir-

ably and when the book comes out he could appropriately name it "Metaphysics."

W. F. MAGIE

PRINCETON, N. J.

ANHYDROUS ALUMINUM CHLORIDE

Anhydrous Aluminum Chloride in Organic Chemistry. By CHARLES ALLEN THOMAS. In collaboration with Mary Baluk Moshier, Herbert E. Morris and Ross W. Moshier. American Chemical Society Monograph Series, No. 87. xiii + 972 pp. New York: Reinhold Publishing Corporation. 1941. $15.00.

AT last there is available a real encyclopedia of the manifold uses of anhydrous aluminum chloride in organic chemistry. Excellent monographs and review articles by Calloway, Groggins, Kränzlein, Montagne, Nenitzescu and others, have appeared within recent years, and have been most helpful, but nothing which has attempted to cover the field with the comprehensiveness and thoroughness of the present volume. Its author and his collaborators have rendered to all organic chemists a service which is sure to receive their grateful appreciation and sincere commendation. As the most complete and up-to-date handbook of the subject, it should be in the chemical library of every educational and research institution concerned with the field of organic chemistry, as well as of those corporations whose industries depend in any way upon the use of anhydrous aluminum chloride.

When "anhydrous aluminum chloride" is mentioned to an organic chemist, there rise instinctively and immediately before him the well-known and ubiquitous "Friedel-Crafts Reactions," and 378 pages of the volume are devoted to syntheses based upon such reactions. It is entirely fitting, therefore, that a portrait of Charles Friedel appears as the frontispiece, and one of James Mason Crafts upon page 76, and that a brief historical sketch (7 pp.) of these two distinguished chemists follows an excellent summarized and generalized introduction.

In addition to the pages occupied as noted abov separate chapters are devoted to the Physical Proper ties of aluminum chloride (45 pp.); the Mechanis of the Reactions Catalyzed by it (20 pp.); Additio Reactions (140 pp.); Aldehyde Syntheses; Aromati Halogenation; Dehydrating Condensations (32 pp.) Dehydrogenation Condensations and Reduction Ph nomena (20 pp.); Miscellaneous Condensations (2 pp.); Aromatic Rearrangements and Migrations (2 pp.); Effect of Aluminum Chloride on Aromati Compounds (22 pp.); Aluminium Chloride in Ali phatic Chemistry (60 pp.); Polymerization (26 pp.) Aluminum Chloride in the Petroleum Industry (2 pp.); Preparation, Manufacture and Purification o Aluminum Chloride (24 pp.); and Notes on the Appli cation of Aluminum Chloride (storage, transporta tion, particle size, etc.). In addition to complet author and subject indexes, there is an index of som 1,400 U. S. and foreign patents. References to th original literature appear throughout the text, th total number of such citations amounting to severa thousand.

Paper, binding and presswork are up to the usua high standards of the publishers.

The two main purposes of the American Chemi Society Monograph Series are stated to be: (1) t present the knowledge available upon the chosen topi in a form intelligible to those whose activities ma be along a wholly different line, to the end that othe chemists may realize how closely their own investig tions may be connected with other work which on th surface appears far afield; and (2) to promote re search in the branch of science covered, by furnishin a well-digested survey of the progress already mad and by pointing out directions in which investigati needs to be extended. Both of these purposes ar well served in this latest addition to the series.

MARSTON T. BOGERT

COLUMBIA UNIVERSITY

SCIENCE TWENTY-FIVE YEARS AGO

BOTANY AS A NATIONAL ASSET[1]

IN connection with the organization of the National Research Council, I feel that American botany is offered a great opportunity of which we should take advantage. As a member of the council I wish to acquaint you with its purpose, so far as botany is concerned. Since the organization of the council was stimulated by the desire to develop a program of national preparedness, the natural first impressi would be that, so far as botany is concerned, it merely the problem of more efficient food producti and distribution. This would stamp the enterpr at once as a problem of practical agriculture, in co nection with which botanical investigators who a dealing with the fundamental problems of pla would have little or no part. Nothing is further fr the intention of the council. The chairman has re cently outlined the work of the council briefly a follows:

[1] Concluding part of the presidential address before the Botanical Society of America, given in New York in December, 1916, and printed in the issue of SCIENCE for March 9, 1917.

1. To prepare a national census of research, showing at laboratories and investigators are available.
2. To encourage the cooperation of educational and research institutions in working out problems of pure science d industry.
3. To promote research in various branches of science in operation with leading national scientific societies.
4. To encourage scientific research in educational institions. It is proposed, for instance, that in each advced educational institution there be a committee on search to promote original investigations on the part the faculty and graduate students.
5. To establish research fellowships in educational institutions, thus affording qualified workers an opportunity devote themselves entirely to research work.
6. To secure wherever possible endowments for research rposes.

It is evident that so far from being primarily work the practical application of what we know already, e enterprise is intended to be primarily a stimulus fundamental research in every direction. It is not *ctical application* that is to be stimulated chiefly, t *exploration,* which may or may not result in prac- al application. It is felt, for example, that the re we know about the structures and activities plants, the better equipped we shall be to handle nts intelligently. Our botanical program, there- re, is simply to extend the boundaries of our knowl- e of plants as far as possible. In pursuance of is program, at least two things are felt to be cessary.

In the first place, there must be developed some heme of cooperation among our botanical estab- lments; and notably between the research establish- nts and the so-called practical establishments. For mple, we recognize in general three great botanical ncies at work to-day, working independently, and in too great ignorance of each other's results. These agencies are the Department of Agriculture, the agricultural colleges and experiment stations, and the universities. All these agencies are investigating plants from various points of view, but they are not as mutually helpful or even as mutually stimulating as they should be in the interest of progress. I have met many cases of men intellectually equipped to work, but with no adequate material or equipment; and also even more cases of fine equipment and abundant material, and no man trained to use them effectively. In other words, the distribution of men and equipment is not as effective as it should be.

In the second place, there must be developed some plan of supporting research wherever there is a competent investigator. The movement to establish research fellowships has begun already, and as the value of research becomes better understood, there is no reason to doubt that every botanical explorer will have the opportunity to explore. There is at present a tremendous amount of waste in the investigators produced by the universities. Every year scores of young investigators, well equipped to continue exploration, are automatically side-tracked by a degree, and forced into positions where investigation is killed, or at least becomes anemic. The council proposes to conserve some of this investigative ability, and to give it a chance to express itself. In short, the opportunity now presented to us is to increase the opportunities for botanical research to such an extent by cooperation and conservation of investigative ability that the progress of botany should take on a greatly increased momentum. And all this can be done if at this psychological moment we as botanists can make it clear that a fundamental knowledge of plants is a great national asset.

THE LATE JOHN M. COULTER

REPORTS

THE AUSTRALIAN NATIONAL RESEARCH COUNCIL

IN October, 1940, the Australian National Research Council according to the *Australian Journal of Science* submitted proposals to the Prime Minister his request, for a Scientific Advisory Committee the lines of the Hankey Committee in Britain and President's Scientific Advisory Committee in the ited States of America. These proposals proved be unacceptable, but an alternative arrangement approved whereby the A.N.R.C. was to maintain e contact with the executive of the Council for ientific and Industrial Research through a special presentative. This arrangement was to be reviewed ter twelve months.

As a result of the past year's experience the executive committee has made a request to the Commonwealth Government that it should authorize two men, selected for their knowledge of industry and science, to spend about three months examining the situation by consultation with leaders in industrial and other war activities. These two men would submit to the Prime Minister proposals for increasing the effective use of the country's scientific resources.

This proposal was first discussed fully with the Council for Scientific and Industrial Research, which has agreed to support the A.N.R.C. in this proposal.

The following is a brief review of some of the activities of the executive committee during the past twelve months.

Contact has been established between the Australian National Research Council and the following:

(i) The Executive of the Council for Scientific and Industrial Research.
(ii) The Adjutant General.
(iii) The Director General and Secretary of the Ministry of Munitions.
(iv) The Director General and Secretary of the Department of Supply and Development.
(v) The Chief Draughtsman, Maribyrnong.
(vi) The Controller of Materials, Ministry of Munitions.
(vii) The Assistant Controller of Industrial Chemicals.
(viii) The Chairman, Medical Equipment Control Committee.
(ix) The Department of Information.
(x) The N.S.W. Contracts Board.
(xi) The Army Medical Services.

The result of these contacts is that several scientific problems arising out of the nation's war effort have been dealt with by scientists in universities and elsewhere. The following are examples of this:

(*a*) A committee of chemists has, in cooperation with the Assistant-Controller of Industrial Chemicals, Ministry of Munitions, prepared a list of chemicals needed in Australia for industrial and analytical work and not manufactured here. The committee has initiated research work on some of these chemicals.

(*b*) The A.N.R.C. has initiated work on the preparation of fire-foam stabilizers (formerly imported) from peanut shells in Australia. This manufacture is about to begin on a scale large enough to supply all Australian requirements and, if required, to export abroad.

(*c*) The A.N.R.C. has initiated research work on the production of sensitizers, essential for engineering drawings, from chemicals available in Australia. In Maribyrnong alone over 2 million square feet *per annum* of this paper are used in munition manufacture, and it is all imported. Research to produce sensitizer has so far been successful, and at present the A.N.R.C., with the cooperation of the Ministry of Munitions, is about to conduct tests which will determine whether an Australian-made sensitizer can replace the imported material in munitions work.

(*d*) The Drug Sub-committee of the Association of Scientific Workers is affiliated to the Australian National Research Council and conducts its negotiations with the Medical Equipment Control Committee largely through the Australian National Research Council's representative. With the help of these negotiations several pieces of work of national importance have been done by the sub-committee.

(*e*) A sub-committee of the A.N.R.C. in collaboration with the Medical Equipment Control Committee has been examining the situation regarding the supplies of essential veterinary drugs.

(*f*) A sub-committee of the A.N.R.C. investigated the possibility of local agar manufacture, with the cooperation of C.S.I.R., and made recommendations concerning the importation of agar supplies for essential pathological and scientific work.

(*g*) A liaison officer has been appointed between Eastern Command and the Australian National Research Council to assist in the solution of scientific problems arising in the Army. The liaison officer, Major Pulling, is attached to the General Staff of Eastern Command.

(*h*) The A.N.R.C., with the agreement of the executive of C.S.I.R. and the vice-chancellors of Australian universities, will examine and comment upon the annual reports of the expenditure of the Commonwealth Research Grant to universities, and will publish summaries of the reports.

(*i*) Through its contact with the N.S.W. Contracts Board, the A.N.R.C. has been asked to give advice on technical difficulties in the fulfilment of war contracts.

(j) The A.N.R.C. has pressed for the appointment of entomologists to the A.I.F.

(*k*) The A.N.R.C. called a conference of representatives from the Australian universities and from C.S.I.R. to discuss the need for training workers in agricultural economics, in view of the need for collecting information before agricultural policy is determined.

SPECIAL ARTICLES

EQUILIBRIA IN AN ANTIGEN-ANTIBODY REACTION

ACCORDING to a theory of immune precipitation developed elsewhere,[1] an equilibrium constant for the *initial reactions* between antigen (G) and antibody (A)

$$G + xA = GA_x$$

may be written

$$K_v^* = \frac{[\text{Satisfied valences}]}{[\text{free valences of G}]\,[\text{valences of free A}]}$$

$$= \frac{G_o x}{G_o(g-x)Ca} \text{ mol}^{-1} \text{ liters}$$

where "valence" is defined by the identity, G_o is the initial concentration of G, C is the equilibrium concentration of A, g is the maximal valence of G, and a the maximal valence of A. This formulation requires three assumptions: that the initial reactions are bimolecular, that the strength of the forces binding

[1] A. D. Hershey, *Jour. Immunol.*, 42: 455, 1941.

* The constant k ($=1000/K_v$) employed in (1) refers to the dissociation of the A–G complex, and to the unit volume 10^6 ml.

specified A molecule to G are not modified by the presence of other bound A molecules, and that the forces binding different A molecules are the same. The second assumption differentiates this equilibrium from that between $H^{\cdot}$, HCO_3^{-}, and CO_3^{--}, and the third distinguishes it from adsorption on heterogeneous surfaces.

It was shown further[1] that precipitation occasions a minimal disturbance of the initial equilibrium when $x = g - x = g/2$, so that, approximately,

$$K_v = \frac{x}{Ca(g-x)} = \frac{1}{aC} \qquad [1]$$

after precipitation at this optimal ratio.

K_v does not refer to concentrations in the ordinary sense, but measures directly the strength of the valence forces, in terms permitting comparisons between different systems. This constant, if validly determined, is therefore of considerable immunologic significance.

It is the object of the present paper, however, to obtain the usual

$$K_c = \frac{[GA_x]}{[GA_{x-1}]\,[A]} \text{ mol}^{-1} \text{ liters} \qquad [2]$$

which has a different utility.

From data of Heidelberger and Kendall cited in reference 1, table 2, we estimated that the reaction of ovalbumin in rabbit antiserum 3.87II could be described by the parameters $a = 2$, $g = 5$, $K_v = 2.9 \times 10^5$. That is, at the point $x = 2.5$, $C = 1.7 \times 10^{-6}$ mols per l. We wish now to characterize, by means of K_c, the initial bimolecular reactions possible to this system (Table 1).

TABLE I

EQUILIBRIUM CONSTANTS AND FREE ENERGY DATA FOR AN OVALBUMIN-ANTIOVALBUMIN REACTION (DATA OF HEIDELBERGER AND KENDALL[a])

Reaction	K_v*	K_c	$-\triangle F^\circ = RT \ln K_c$
	$\times 10^5$	$\times 10^5$	cal.
$\frac{1}{x} G + A = \frac{1}{x} GAx$ ..	2.9	...	7000†
$G + A = GA$	"	29	8300
$GA + A = GA_2$ ...	"	12	7800
$GA_2 + A = GA_3$ ...	"	5.8	7400
$GA_3 + A = GA_4$ ...	"	2.9	7000
$GA_4 + A = GA_5$ ...	"	1.2	6500

Standard state: Aqueous solutions of the order 10^{-5} M in serum diluted 1:5 with 0.15 M NaCl.
Temperature: 0 C.
[a] M. Heidelberger and F. E. Kendall, *Jour. Exp. Med.*, 62: 697, 1935.
* The constancy of K_v for the successive reactions is in part an assumption (see A. D. Hershey, *Jour. Immunol.*, 1941, on which the validity of the computed K_c's depends.
† $RT \ln K_v$, *i.e.*, the decrease of free energy associated with formation of the G–A bond. The remaining values have the usual significance.

It is evident from the assumptions made above that, for the mean value $x = 2.5$, the mol fractions of the various GA_x's participating in the initial equilibrium may be obtained from the successive terms of the expansion $(p+q)^n$ where $n = 5$, $pn = 2.5$, $p = 0.5$ and $q = 1-p$. Accordingly,

$$\begin{aligned}
\text{mol fraction } G &= 0.03125 \\
" \quad " \quad GA &= 0.15625 \\
" \quad " \quad GA_2 &= 0.31250 \\
" \quad " \quad GA_3 &= 0.31250 \\
" \quad " \quad GA_4 &= 0.15625 \\
" \quad " \quad GA_5 &= 0.03125
\end{aligned}$$

from which since $[A] = 1.7 \times 10^{-6}$, the values of K_c for the successive reactions may be obtained by [2].

This method is alternative to another, which is less obvious but considerably more convenient when g and n are large. Thus for the single reactions

$$GA_{x-1} + A = GA_x$$

$$K_v = \frac{x[GA_x]}{(g-x+1)\,[GA_{x-1}]\,2[A]} = \frac{x}{2(g-x+1)} K_c \qquad [3]$$

The K_c's computed by [3] are identical with those given by [2].

In Table 1 these values are listed for the successive reactions, together with $\triangle F^\circ = -RT \ln K$ referred to the arbitrary standard state represented by dilute solutions of the reactants in serum diluted with 0.15 M NaCl.

The striking feature of the ovalbumin-antiovalbumin reaction is the very large value of the equilibrium constants, which could scarcely be determined at all except for the large molecular size of antibody. This is, however, in keeping with the well-known "irreversible" character of the A–G reaction.

It should be noted that the equilibrium constants of the successive reactions decrease very markedly as x increases, which accounts for the partial recovery of antibody by dissociation from precipitates formed in the region of A excess[2,3,4] and failure in other regions.[3,4,5] This result, as here interpreted, does not imply "a graduated variability in the firmness of union"[2] of successive A molecules, a conception rather generally accepted at present.[6,7] On the other hand, this possibility can not be excluded by ignoring it, as is done by the assumptions made in the present theory. Experimentally, one observes only a minor variation of K_v computed for different points in the reaction range, and this has been attributed to the secondary effects of precipitation.[1] The significant fact is that the results achieved appear to justify the simpler assumptions. It remains to be seen within what quantitative limits this is true.

[2] F. M. Huntoon, *Jour. Immunol.*, 6: 117, 1921.
[3] M. Heidelberger and E. A. Kabat, *Jour. Exp. Med.*, 67: 181, 1938.
[4] A. D. Hershey, G. Kalmanson and J. Bronfenbrenner. Unpublished.
[5] P. H. DeKruif and J. H. Northrop, *Jour. Gen. Physiol.*, 5: 139, 1922–23.
[6] J. R. Marrack, "The Chemistry of Antigens and Antibodies." Great Britain Medical Research Council, Special Report Series No. 230, 1938.
[7] Szu C. Liu and H. Wu, *Chinese Jour. Physiol.*, 16: 97, 1941.

The question of the reversal by dissociation of the *biologic effects* of immune reactions may be somewhat clarified in view of the variations of K_c for the successive reactions. Thus, other parameters being the same, a system in which the "neutralization" of a molecule of antigen brought about by reaction with considerably less than g molecules of A might appear irreversible, whereas in a system in which neutralization requires many ($\sim g$) molecules of A, reactivation should be readily demonstrable. In practice, success depends on whether the necessary degree of dilution, and the necessary lapse of time, are experimentally feasible.

The free energy data offered are, of course, subject to those errors,[1] of unknown magnitude at present, affecting the measurement of K_v. The values appear to be reasonable. In fact, Boyd *et al.*[8] recently assumed that $\Delta F^\circ = -10^4$ cal. for a similar reaction "which goes very nearly to completion but may be reversed experimentally."

We are now studying the phage-antiphage equilibrium,[4] which is in some respects more amenable to measurement, with the expectation of obtaining a more complete thermodynamic description of this typical immune reaction.

A. D. HERSHEY

WASHINGTON UNIVERSITY
SCHOOL OF MEDICINE,
ST. LOUIS

EFFECT OF INSULIN ON PYRUVIC ACID FORMATION IN DEPANCREATIZED DOGS[1]

PREVIOUS work on man has revealed an increase in pyruvic acid in the blood following the ingestion of glucose.[2] In diabetic subjects no increase in blood pyruvic acid occurred under the same conditions. The administration of insulin together with glucose to these patients resulted in an increase in blood pyruvate.[3] In order to study the relationship between insulin and pyruvic acid formation 27 experiments have been performed on 14 depancreatized dogs. The animals were maintained with insulin and pancreatin until 72 hours before each observation. The method for estimating pyruvic acid was modified to eliminate interference by the 2, 4 dinitro-phenylhydrazone of acetoacetic acid.[4,2]

Experiments on normal animals disclosed a significant rise in blood pyruvate over the fasting value after the intravenous injection of 2 gm of glucose per kg body weight. In depancreatized dogs there was no rise in blood pyruvate after a similar injection of glucose. When insulin was administered simultaneously with the glucose a marked rise in pyruvate occurred (see table I representing a typical experiment) reaching its maximum from one to three hours after the injection. If a second injection of glucose was made four hours after the administration of insulin a second rise in pyruvic acid took place. When the blood sugar level was raised to 750 to 950 mg per cent. for 3 to 5 hours by a continuous infusion of a 5 per cent. glucose solution, (300 ml per hour) after a preliminary injection of 2 gm glucose per kg, an elevation of blood pyruvate occurred despite the absence of insulin. The blood pyruvate under these conditions reached a constant level within one or two hours. The injection of insulin after three hours of glucose infusion produced a further rise in blood pyruvate.

TABLE I

BLOOD PYRUVIC ACID AND BLOOD SUGAR AFTER THE INTRAVENOUS INJECTION OF GLUCOSE (2 GM PER KG) INTO A DEPANCREATIZED DOG (BOTH EXPERIMENTS WERE PERFORMED ON THE SAME ANIMAL)

Time	No insulin		40 units insulin	
	Blood pyruvic acid mg per cent.	Blood sugar mg per cent.	Blood pyruvic acid mg per cent	Blood sugar mg per cent.
Before injection	1.28	380	1.14	337
10 min. after "	1.23	775	1.35	725
20 " " "	1.28	662	...	...
30 " " "	1.29	572	2.52	445
45 " " "	1.28	515	...	...
60 " " "	1.19	478	3.46	279
90 " " "	1.22	438	...	...
120 " " "	...	...	3.12	243

In agreement with previous observations[5] the rate of removal of intravenously injected pyruvic acid (1 gm per kg as sodium pyruvate) from the blood was the same in normal and depancreatized dogs.

It may be concluded from these experiments that in the depancreatized dog, insulin increases the formation of pyruvic acid after the administration of glucose.

ERNEST BUEDING

NEW YORK UNIVERSITY
COLLEGE OF MEDICINE

JOSEF F. FAZENKAS
HERMAN HERRLICH
HAROLD E. HIMWICH

ALBANY MEDICAL COLLEGE,
UNION UNIVERSITY

[8] W. C. Boyd, J. B. Conn, D. C. Gregg, G. B. Kistiakowsky and R. M. Roberts, *Jour. Biol. Chem.*, 139: 787, 1941

[1] Aided by grants from the John and Mary R. Markle Foundation and the Williams-Waterman Fund of the Research Corporation.

[2] E. Bueding, M. H. Stein and H. Wortis, *Jour. Biol. Chem.*, 140: 697, 1941.

[3] E. Bueding, H. Wortis and H. Fein. Unpublished observations.

[4] D. Klein, *Jour. Biol. Chem.*, 137: 311, 1941.

[5] E. Flock, J. L. Bollman and F. C. Mann, *Jour. Biol. Chem.*, 125: 49, 1938.

SCIENTIFIC APPARATUS AND LABORATORY METHODS

A SENSITIVE HUMIDISTAT

THE unreliability and low sensitivity experienced with a commercial hair humidistat led to the development of a control operated by the differential in temperature between ether-filled wet and dry bulbs. The difference in vapor pressures of ethyl ether contained in the bulbs (see diagram) due to the temperature difference displaces a mercury column across the platinum contacts sealed in the connecting tubing.

Approximate adjustment for the desired humidity range is obtained by varying the amount of mercury in the manometer tube by adding or subtracting from a reserve supply stored in the bulbs. Final adjustment is made by swinging the instrument about a pivot. The 13 cm distance apart of the manometer legs facilitates the changing of the mercury level with respect to the upper platinum contact. With the instrument illustrated, a removable paper scale serves for approximate testing, but final adjustment must be made by trial and error for precise values, since the wet-dry bulb differential as well as the ether vapor pressure difference depends to a degree upon the environmental temperature.

The large reservoir serves to supply the wick cup with distilled water over an extended period of time. The constant-level device utilized is indicated in the diagram.

The practical sensitivity of the control depends to a large extent upon the rate of change of humidity in the environment and air flow over the bulbs. Sling psychrometer readings indicate, however, that in a closed constant-temperature room, control has been obtained well within 1 per cent. relative humidity of the desired value. In the original design, the instrument was adjusted so that one end of the mercury column moved along only a slight upward incline. Such an arrangement gives approximately twice as much movement of the mercury column for a given pressure differential as the normal arrangement. Further increase in sensitivity might be obtained by utilizing the principle of the sloping manometer.

The vertical manometer tube must be sufficiently long so that the lowest humidity will not cause displacement of the mercury into the wet bulb and necessitate readjustment. In the instrument illustrated the 11 cm is sufficient for stability down to approximately 12 per cent. relative humidity at 25° C. If the instrument is to operate at low humidities, it would be essential to extend the tubes for a distance of about 35 cm above the level of the top platinum contact. Calculations of the height required are easily made for any given set of conditions by reference to data upon vapor pressure of ether[1] and to psychometric tables.[2]

No difficulties have been encountered due to the inflammable nature of ether. The instrument was filled with dry ether after addition of sufficient mercury. The outlet was sealed off after slowly boiling

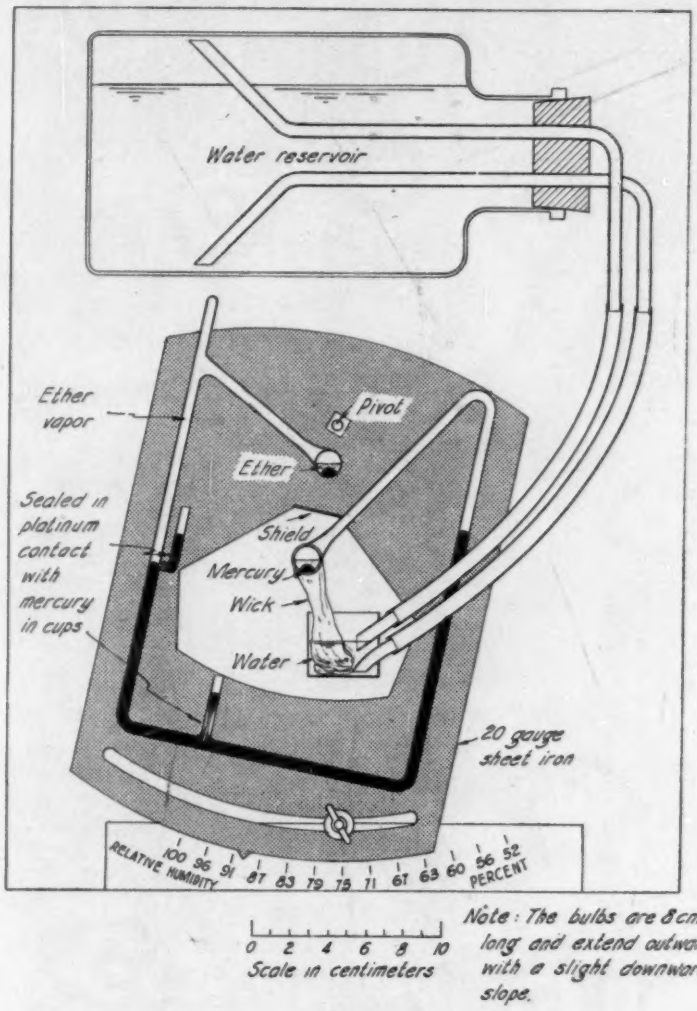


FIG. 1

away the excess ether under reduced pressure, leaving only enough ether to slightly less than half fill both bulbs, which are about 8 cm long and extend outward sloping slightly downward. (Not clearly illustrated in the sketch.) The sealing off is carried out with the ether still boiling so that any residual air would be insufficient to cause an explosion or to exert a partial pressure which would interfere with the operation of the instrument. While the relatively nonexplosive chloroform might be utilized, the vapor pressure change at room temperature is only about one third that of ether. The reduced sensitivity would probably not be of importance for many applications but would be advantageous in order to reduce the tube length required at low humidities.

[1] International Critical Tables.
[2] *U. S. Dept. Agr. Weather Bureau Bul.* 235. 1937.

A sensitive relay is required, as otherwise the heating at the mercury-platinum contact is sufficient to cause trouble in the operation of the instrument; however, either a 2 ma 110 V. AC or a 10 ma 6 V. DC relay has been found satisfactory. The relay should be normally closed for the instrument as illustrated if used in a humidifying system.

W. O. WILLIAMS
UNIVERSITY OF CALIFORNIA, DAVIS

SECTIONING AND STAINING REFRACTORY MATERIALS IN PARAFFIN

MANY tissues, as, for example, the lens of the vertebrate eye, are difficult or impossible to section in paraffin with ordinary methods. Such materials may be cut in celloidin, but the celloidin method has several disadvantages, chief of which are (1) the impracticality of cutting thin sections and (2) the difficulty of keeping serial sections in order.

None of the steps in the paraffin method to be described here are new—in fact, all are to be found in the tenth edition of Lee's "Microtomist's Vade-Mecum"—but they have been combined in an unusual way and the results obtained have been more than satisfactory.

The steps in the method, as it was finally developed, are as follows:

(1) Fix material in Bouin's solution;

(2) Transfer, without washing, to 100 per cent. dioxan and change once during an eight-hour period;

(3) Transfer to paraffin containing 0.5 per cent. beeswax and change twice during an eight-hour period;

(4) Embed in the usual manner and then expose tissue by cutting away one side of the block;

(5) Soak block in water for at least twenty-four hours before sectioning;

(6) Section;

(7) Place section (or sections) on water on clean slide and warm gently;

(8) Allow to cool and replace water with solution No. 1 of Mallory's triple connective tissue stain. Stain for five minutes;

(9) Drain off first stain and replace with Mallory's solution No. 2. Stain for five minutes;

(10) Drain off second stain and replace with water;

(11) Drain off water immediately and replace with 95 per cent. alcohol;

(12) Drain and repeat with absolute alcohol;

(13) Center section on slide and run over it a few drops of 0.5 per cent. celloidin (dissolved in equal parts of ether and alcohol);

(14) Dry for several hours or overnight;

(15) Clear in xylol;

(16) Mount in balsam or clarite.

The materials used in testing the method consisted of the following: frog heads (adult *Acris gryllus* and recently metamorphosed *Rana pipiens*); skin from frog (*Rana pipiens*); skin from seven-day old rat; grasshopper eggs (*Melanoplus differentialis*); amphibian eggs in early cleavage stages (*Triturus* sp.); compound eyes from grasshopper (*Melanoplus differentialis*); compound eyes from beetle (*Dytiscus* sp.); human lens with cataract; and pathological human liver tissue.

All were sectioned at 4 and 6 micra with unbelievable ease except the *Dytiscus* eyes which could not be cut successfully at less than 8 micra. On the other hand, frog's skin and frog's head, including the lenses of the eyes, were sectioned at 2 micra.

Cellular details were found to be even better than those obtained with ordinary paraffin methods. Such structures as intercellular bridges, rods and cones of the retina, the cytoplasm of the cells in the lacunae of cartilage, ciliated epithelium of the oral cavity, muscle striations and the cells surrounding the lens in the sections of the frog's head were in excellent cytological condition. Mallory's stain, when used as described above, shows greater delicacy and precision than is obtained when sections are stained after the removal of the paraffin. Another advantage of the method lies in the fact that tissues such as vertebrate lens and insect cuticle remain flat and do not curl away from the slide as they almost invariably do when sections containing them are spread and dried in the usual way.

The method outlined above is rapid, simple, gives perfect, thin, serial sections of materials ordinarily very difficult to cut and insures fine cellular detail.

The authors are indebted to Dr. James H. Allen, of the Department of Ophthalmology, Medical School of the State University of Iowa, and to Drs. R. L. King, L. O. Nolf and T. L. Jahn, of the Department of Zoology, for supplying the tissues.

THEODORE N. TAHMISIAN
ELEANOR H. SLIFER
STATE UNIVERSITY OF IOWA

BOOKS RECEIVED

ARMBRUSTER, DAVID A. *Competitive Swimming and Diving.* Pp. 301. Mosby. $3.25.

DUKES, H. H. *The Physiology of Domestic Animals.* Fifth edition. Pp. xiv + 721. Cornell University Press.

LYNCH, THERESA I. *Communicable Disease Nursing.* 156 illustrations, 5 color plates. Pp. 378. Mosby. $3.75.

SHULL, A. FRANKLIN. *Laboratory Directions in Principles of Animal Biology.* Fifth edition. Pp. ix + 102. McGraw-Hill. $1.00.

Standard Plant Names. Prepared by the editorial committee, HARLAND P. KELSEY, chairman of the American Joint Committee on Horticultural Nomenclature. Second edition. Pp. xv + 675. J. Horace McFarland Co. $10.50.

SCIENCE NEWS

Science Service, Washington, D. C.

THE PRE-TRAINING OF AVIATORS

STREAMLINING of college courses in mathematics, physics, astronomy and weather science to offer pre-training for the 450,000 new aviation personnel required this year and next for President Roosevelt's expanded aviation program is recommended in the report of a committee appointed by the Secretary of War. This committee, which was nominated by the American Association for the Advancement of Science, consists of Dr. William L. Hart, University of Minnesota; Dr. W. M. Whyburn, University of California at Los Angeles, and Dr. C. C. Wylie, the State University of Iowa. They studied the problem of the ground training and preliminary training that might be given in high schools and colleges to insure an adequate flow into the armed forces of properly trained pilots, navigators, bombardiers and other aviation personnel. They observed the training in progress at Maxwell Field and other fields in the Southeast Air Corps Training Center.

The magnitude of this job facing educational institutions is emphasized in an announcement by Dr. F. R. Moulton, permanent secretary of the association, of the planned streamlined curriculum for colleges. He says:

"The program of production of military planes which President Roosevelt announced two or three weeks ago (50,000 planes in 1942 and 125,000 in 1943) calls for at least a trained aviation personnel of 150,000 men this year and 300,000 next year. An unknown fraction of these requirements will have had a considerable part of the necessary college training and will enter the service directly.

"It will be of very great aid to the national defense to give as many of the remainder as possible most of their pre-training in educational institutions. If the numbers to be trained in schools should be half the total required, or 75,000 and 150,000 in the two years, the number of classes would necessarily be enormous and the facilities of the universities would be taxed. Consequently, it is important to start the courses at once in as many institutions as possible, partly to prepare men for the air service as rapidly as possible and partly to gain experience for a greatly increased effort. It is likely that many changes and improvements will be made in present plans under the teachings of experience."

The committee believes that the new college course as outlined by the committee can be telescoped into 11 or 12 weeks for students who have had advanced high-school algebra and some solid geometry. Emphasis throughout is on practical applications and manipulation. Theory is kept to the minimum necessary for understanding of the work.

In the plane trigonometry course, students will use a slide rule and each is expected to possess a cheap one of his own. In solid geometry, proofs will be held to a bare minimum; great emphasis will be placed on the drawing of figures and making simple paper models for three-dimensional situations. In spherical trigonometry, emphasis will be on problems of latitude, longitude and the astronomical triangle on the celestial sphere; examinations will be of the "open book" type, the object being to give the student confidence later in the use of navigation tables. Problems of the navigator will be kept in mind in the astronomy and weather course. The physics course will not be of the theoretical type.

CRYSTALLINE SOLIDS AND LIQUIDS

"GHOSTS" of ice lurk in water, and all liquids have some slight residual structure which is like a memory of a former crystalline solid state. This latest finding of science was described at the University of Minnesota by Dr. John G. Kirkwood, professor of chemistry at Cornell University. Dr. Kirkwood spoke under the auspices of the Society of the Sigma Xi.

When a solid melts, the long-range crystalline order that extended throughout the mass of the solid, disappears completely, but some trace of the short-range local organization persists, he explained. Each molecule in the liquid tends to retain some of its former neighbors about it.

That liquids are mobile and solids are rigid does not adequately describe the distinction. For glass is to be regarded as an undercooled liquid that failed to crystallize on solidifying. Yet it has great rigidity while crystalline solids may show plastic flow at high temperatures. The real distinction is the degree of orderliness in the arrangement and distribution of their molecules. In the crystalline solid, the degree of order is high and extends over wide domains. In the liquid, it is slight and confined to local groups. Nevertheless, some remains, both in liquids and gases. This residual orderliness in liquids is revealed by x-ray scattering, the same technic that has so precisely determined the crystal structure of solids.

Dr. Kirkwood has reduced "degree of local order" to a mathematical expression, the "radial distribution function." X-rays determine the value of this function, and conversely, if the function is known, some of the properties of the liquid can be predicted.

THE DISCOVERY OF A RED STAR

A FEW weeks ago the Harvard College Observatory received a radiogram from Professor Jean Bosler, director of the Marseilles Observatory in France, announcing the discovery by the astronomer R. Jonckheere of a "remarkable red star" and asked for its spectrum.

No spectrum of this star was to be found on any of the existing Harvard photographic plates, so Robert Fleischer made one with the observatory equipment on a red sensitive plate.

The star turned out to be truly red. Its spectrum is confined to the red end of the rainbow sequence of colors, the end which does not photograph at all on a blue sensitive plate. The spectrum, examined by Dr. Dorrit Hoffleit, was declared to be of type Nb, to which only the reddest of the red stars belong. The star itself was also pho-

graphed one night, both on a red and on a blue sensitive plate. It showed up brightly on the former, not at all on the latter.

However, the star was found on 120 Harvard plates taken during the past several years. Examination of these plates disclosed that the star varies—blinks—but takes about 500 days between blinks. At its brightest, it is about three magnitudes, or 16 times, brighter than at its dimmest. But even at its best it is around 16 times too faint to be seen with the unaided eye.

The star is in the constellation Monoceros, which lies between Orion and Canis Minor, the Lesser Dog.

BLOOD PLASMA

FROZEN dried blood plasma, which is saving lives of soldiers wounded in the present war, offers new hope to patients with hemophilia, the hereditary disease in which the slightest cut or injury may cause dangerous or even fatal bleeding. This appears from a report by Dr. John M. Johnson, of the University of Rochester School of Medicine, in the forthcoming issue of the *Journal* of the American Medical Association.

Weekly injections into the veins of about four ounces (125 cubic centimeters) of plasma enabled a patient totally disabled by hemophilia to do light work. For the previous three years his activity had been greatly restricted because of recurrent bleeding.

Because of the limited supply of plasma Dr. Johnson has not attempted to give all his patients injections of plasma at regular intervals, but he considers intensive treatment of incipient hemorrhages with plasma the most practical method of attempting to rehabilitate patients with hemophilia.

Transfusions of fresh whole blood have heretofore been considered the most effective treatment. Plasma, Dr. Johnson says, has the same ability as whole blood to shorten the clotting time of the blood, which in hemophilia is so prolonged that the patient is in danger of bleeding to death from small injuries. In addition, plasma has the following advantages: It is more readily available than whole blood, since it can be stored after suitable processing without losing its ability to reduce clotting time. It does not need to be typed or matched with the patient's blood.

One of the most satisfying results of the type of management under discussion has been the elimination of the fear of tooth extractions in patients with hemophilia. The removal of two or more teeth on three occasions in two patients was managed by the use of plasma alone.

ITEMS

FOSSILS showing that life existed half a billion years ago in a shallow sea where the Appalachian Mountains now rise, have been found in a series of limestone strata long thought to be barren of such evidences. The formation is described in a new publication of the Smithsonian Institution, by Dr. Charles E. Resser, paleontologist of the U. S. National Museum. The strata constitute what is known as the Maryville formation. It crops up in many places in the long chain of Eastern mountains. Geologically, it is classified as of mid-Cambrian age. The fossils, mainly of ancient relatives of crabs and crayfish known as trilobites, are related to similar forms found in the Rocky Mountains.

THE Adirondack Mountains are half as old as the earth itself. New measurements of the age of these northern New York uplands, based on the relative amounts of thorium and lead in one of the minerals found in them, indicate an antiquity of 1,100,000,000 years. This confirms an earlier estimate, made in 1939, based on a different mineral. The Adirondacks are of the same age as the Laurentian highlands, a much larger ancient mountain mass in Canada, on the other side of the St. Lawrence River, and separated from the Adirondacks by a wide zone of much younger rocks. The new age determination was made on a mineral known as allanite, specimens of which are in the U. S. National Museum, by Dr. J. P. Marble, of a committee of the National Research Council, on the measurement of geologic time. The 1939 determination, made on a uranium-containing mineral known as uraninite, was carried out in a laboratory in Vienna, now inaccessible because of the war.

HOPE that diphtheria toxoid, the substance that protects against diphtheria, would prove a cure for leprosy is dispelled by its failure so far to improve the condition of leprosy patients at the U. S. Marine Hospital, Carville, La. The treatment aroused wide-spread interest when an American medical missionary to Thailand, Dr. D. R. Collier, reported favorably on his results with the treatment which was first suggested by a German physician, Dr. Manfred J. Oberdoerffer. Trial of the treatment was started at Carville in 1940. Of 11 patients given the treatment for more than a year, one is slightly improved, three are in a stationary state and the rest are in a worse condition than at the start of treatment. Dr. G. H. Faget and Dr. F. A. Johansen, of the U. S. Public Health Service, describe these results in the current issue of the *Public Health Reports*. In a more extensive and carefully controlled study, for which seventy-one patients volunteered, diphtheria toxoid was given to half the group and the broth from which it was made was given to the other half. The latter, control group, did better than the group given the toxoid. The experimental treatment will be continued for another two months. After three months of further observation a final report will be made.

THE dangers of allowing mice and termites to inhabit airplanes is the subject of a safety bulletin issued by the Civil Aeronautics Board. A recent fatal accident, in which a mouse was prominent, "presents a good object lesson by which to focus attention on the importance of watching out for insect and animal pests around your plane." During a normal maneuver, the covering on the right wing failed. The plane crashed nose first in a plowed field. The right aileron fabric was found to be badly deteriorated along the piano hinge; the work of a small animal, probably a mouse. During the removal of the wreckage from the scene of the accident a mouse jumped from the fuselage. Other incidents are on record of wood-eating termites and rodents inhabiting aircraft.